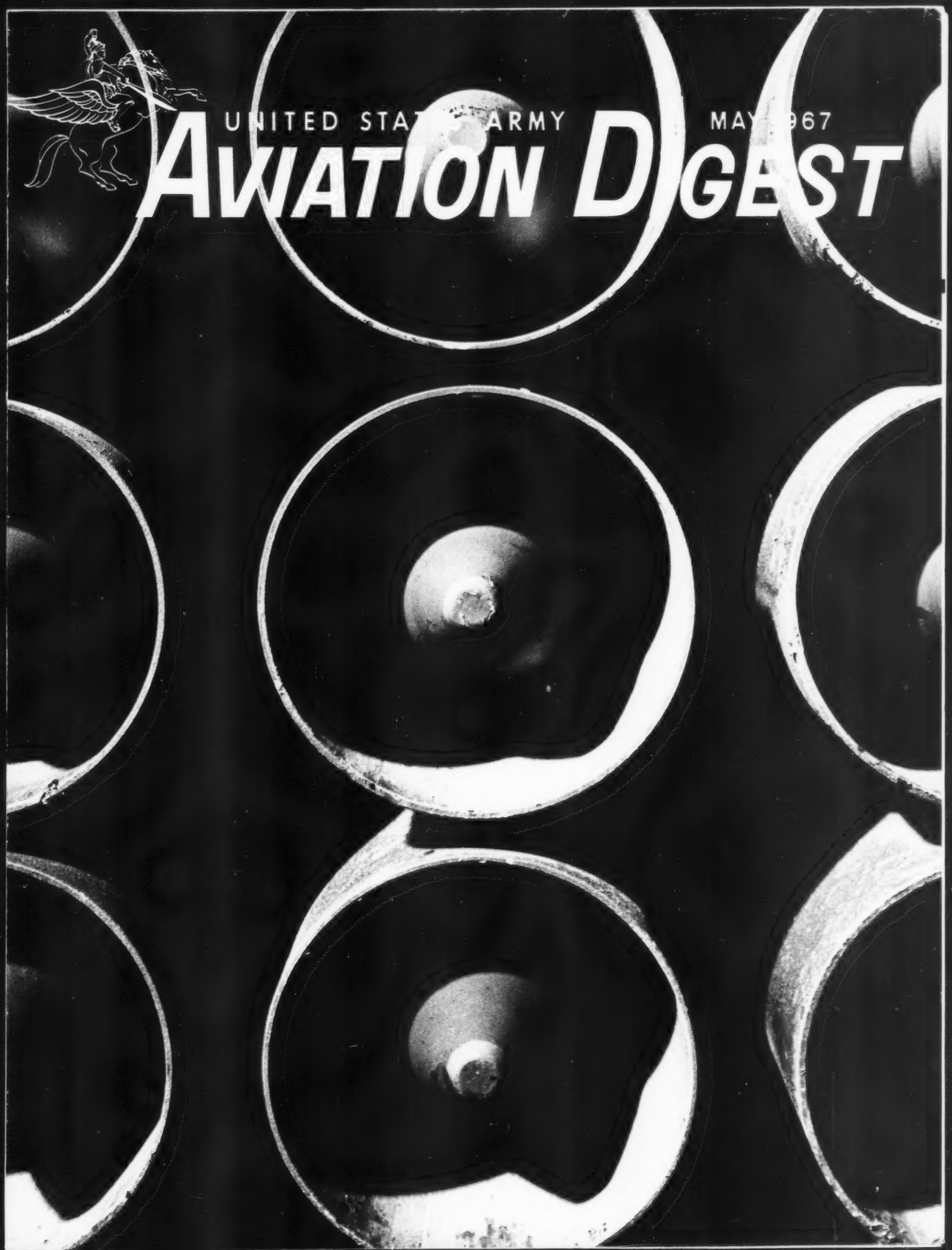
UNITED STATES ARMY
MAY 1967
AVIATION DIGEST

UNITED STATES ARMY AVIATION DIGEST

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MAY 1967 VOLUME 13 NUMBER 5

LETTERS	1
DUSTOFF, CPT Jerry W. Childers	2
HELICOPTER GUNNERY TRAINING IN VIETNAM, COL Raymond P. Campbell, Jr.	4
ADVERTISING—THE KEY TO SELLING YOUR SAFETY PROGRAM	6
WHEN IS IT A FORMATION? MAJ Charles C. Frank	10
THUNDERSTORMS	12
MY FRIEND FUTURE AND HIS CHARIOT, CW3 Valentine Hampton	15
CLOUDS OVER SOON LON VALLEY, CPT Robert S. Fairweather, Jr.	20
MAGNETIC CHIP DETECTORS, COL Edward J. Chrysler	24
M-22s IN COMBAT, CPT James R. Foreman	25
THE WEATHER'S FINE, MAJ Donald R. Drumm	28
CAYUSE IN VIETNAM	31
THE FINE ART OF AERIAL OBSERVATION, CPT Mark L. Bellamy	32
ARE YOU STANDARDIZED OR MECHANIZED, MAJ Herbert H. Guderian	34
CRASH SENSE	
DITCHING THE HUEY, Gerard Bruggink	36
TIGER BY THE TAIL, Ted Kontos	47
PEARL'S	50
A SURPRISE FOR WILMA, Pierce Wiggin	58
YEAR OF THE MINI	64

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

The DIGEST is an official Department of the Army periodical published monthly under the supervision of the Commandant, U. S. Army Aviation School. Views expressed herein are not necessarily those of Department of the Army or the U. S. Army Aviation School. Photos are U. S. Army unless otherwise specified. Material may be reprinted provided credit is given to the DIGEST and to the author, unless otherwise indicated.

Articles, photos, and items of interest on Army Aviation are invited. *Direct communication is authorized to: Editor-in-Chief, U.S. Army Aviation Digest, Fort Rucker, Alabama.*

Use of funds for printing this publication has been approved by Headquarters, Department of the Army, 29 December 1964.

Active Army units receive distribution under the pinpoint distribution system as outlined in AR 310-1, 20 March 62, and DA Circular 310-57, 14 March 63. Complete DA Form 12-4 and send directly to CO, AG Publications Center, 2800 Eastern Boulevard, Baltimore, Md. 21220. For any change in distribution requirements, merely initiate a revised DA Form 12-4.

National Guard and Army Reserve units submit requirements through their state adjutants general and U. S. Army Corps commanders respectively.

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LETTERS

Sir:

The article "Lieutenant by-the-Book" appearing in the October issue of Army Aviation Digest has caused U-1A aircraft operators to become understandably alarmed.

The article implies that the current emergency procedures in TM 55-1510-205-10 for propeller failure (oil supply breakdown) are completely incorrect. To say that the procedures are incomplete rather than incorrect would be more accurate.

Since it is virtually impossible to include procedures for all emergency conditions that may occur, only those with a high probability of occurrence are included. As in any emergency condition, time is of great importance; therefore, effort is made to keep the procedures short and concise.

The present emergency procedures are adequate for all cases of propeller failure (oil supply breakdown) with the exception of failure of the oil line (governor to propeller) and a broken propeller dome. The propeller lines are manufactured from either stainless steel or 1500 psi teflon tubing. The probability of their breaking is extremely remote. (The magazine article does not indicate exactly how failure occurred. An attempt to obtain more information regarding the failure is being made.) A condition that would cause cracking of the dome is inconceivable. However, if the dome does crack, oil being pumped from the governor could be conserved but oil being pumped from the engine would still be lost.

Most propeller failures are due to failure of the constant speed governor. When this occurs, normally the propeller will go into full low pitch (overspeed). The initial efforts on the part of the operator should be to reduce this overspeed because destruction of the engine can result. The current emergency procedures are written to accomplish reduction in overspeed as immediately as possible. Regardless of the possibility that oil may be thrown overboard, these are the initial steps to be taken.

Although breaking of the oil line (governor to propeller) is considered extremely remote, action was taken in July 1965 to include this possibility in a future issue of the operator's manual.

In a forthcoming issue of the operator's manual, emergency procedures for propeller failure in flight will read as follows:

Propeller Failure in Flight
Propeller Lever—Retard
Throttle—Adjust to reduce airspeed to 60 knots IAS
Wing Flaps—Takeoff
Oil Pressure Gage—Check continuously. If oil pressure drops and remains low a broken oil line is indicated. Return propeller lever to "Low Pitch."
Land—As soon as practicable

An important fact to bear in mind is that all oil leakage emanating from the propeller is not oil supply breakdown. Oil may be slung on the windshield from the propeller because of defective seals. Please do not consider oil on the windshield as a sign that oil is being thrown overboard and place the propeller lever in low pitch. Remember the indication that oil is being pumped overboard is when the propeller is in an overspeed condition, the oil pressure drops and remains low when the propeller level is placed in high pitch.

We are hopeful that this information has added clarity to the U-1A aircraft emergency procedures for propeller failure.

COL EDWARD J. CHRYSLER
Director of Research, Development and Engineering
U. S. Army Aviation Materiel Command
St. Louis, Mo. 63166

• *The AVIATION DIGEST is always happy to receive letters from its readers. These denote real interest and understanding of our publication.*

"Lt By-the-Book" has apparently prompted further study and evaluation of the emergency procedures of the U-1A. We are gratified to learn of your actions to revise the operator's manual.

—The Editors

Sir:

The three articles on torque and torque wrenches in the January 1967 issue of the Aviation Digest are excellent.

Copies have been made of these articles and are required reading for our technical inspectors and supervisors of technical inspection.

There is one error in the article "Using the Torque Wrench" I would like to bring to the author's attention. No harm is caused by this error, but future articles may be changed a little because of it. The statement "On the rigid frame and presetting audible click-type wrenches, the point of force application must be in the center of the grip as shown in figure 6" is in error. In the old days when we had to use a fish scale on the grip of a plain wrench it was important to measure the distance of the lever length accurately. However, the two wrenches mentioned in the above statement are constructed and tested to indicate the actual torque applied at the concentric point. For mathematical calculations the torque wrench is specified as a 10 inch, 12 inch, etc., or measured from the concentric point to the center of the handle if length is not known. It makes no difference if an extension is placed on the handle end of the torque wrench. The dial indicator or audible click will still indicate the amount of torque applied at the wrench's concentric point. Figure 7 is invalid as it is not an improper way of applying force, but is an improper method of figuring lever length.

Articles of this type are very beneficial and appreciated by this reader.

WILLIAM S. ANGLE
Chief of Technical Inspection and Test Flight
Page Aircraft Maintenance, Inc.
Ft Rucker, Ala. 36360

• *Sharp-eyed reader Angle is right. When using* modern *torque wrenches (rigid frame with dial indicator, "click" type, etc.) it does not matter at what point on the handle pressure is applied* once the correct torque value the dial is to denote or the wrench set to "break" at *has been established. It is important to properly compute this value when using extension wrenches. As Mr. Angle points out, figure 7 shows an improper method of figuring* lever length. *This length is usually designated by the manufacturer. If not, it can be computed by measuring from the concentric point to the* center *of the handle.*

Many thanks for bringing this to our attention.—The Editors

DUSTOFF

Captain Jerry W. Childers

To the officers of the 197th Aviation Company (UTT), the professionals who lead the way, in appreciation for your unselfish efforts which time after time, have insured the completion of Dustoff's mission, so many of your fellow men have courageously sacrificed life and limb in order that others might live; no man could ask for more.

SO READS a plaque that Saigon's famed armed helicopter company proudly exhibits in the Saber Lounge of their officers' villa. Presented in October 1965, by the 57th Medical Detachment (Dustoff), it tells a story of unparalleled mutual respect. "Dustoff," a fraternity dedicated to saving lives, and "Saber," dedicated to the destruction of the enemy, have combined forces on countless occasions in this war without front lines to extract wounded soldiers from the very midst of the enemy.

Pilots of the 334th Aviation Company (Escort)* will readily admit that escorting Dustoff into a hot area for a medical evacuation is their most dangerous mission. The friendly ground troops are usually in contact with the enemy and Dustoff, helpless to defend itself, is fully dependent on Saber's 40 millimeter grenade launchers, rockets and machineguns for protection.

The North Vietnamese and the Viet Cong are keenly aware of the South Vietnamese soldier's boost in morale when he sees his wounded buddy whisked away to the hospital and will react with fanatical determination when Dustoff's big red cross comes into view. The excitement of close combat, the requirement for close coordination and perfect timing, and the satisfaction that comes from saving a comrade's life combine to produce the armed helicopter pilot's most satisfying assignment. The mission recounted below, chosen solely because it is typical, illustrates the teamwork of Dustoff and Saber.

On the morning of 1 October 1965 four armed helicopters from the 334th's first platoon (Playboys) reported to Tay Ninh, a friendly village about 70 miles northwest of Saigon, to provide support for a ground operation taking place northeast of there. The Playboy pilots found the Dustoff pilots already there. On kidding them about unshaven faces, they found that Dustoff had been there all night. The Playboys refueled and two of the armed helicopters, the Playboy 1-1 fire team, took off to begin their mission. The Playboy 1-7 fire team remained behind to be ready to assist and eventually replace the 1-1 fire team when it got low on fuel.

Shortly after Playboy 1-1 arrived in the operational area the friendly unit, about 160 South Vietnamese special forces troops with American advisors, were pinned down by enemy fire. The Viet Cong occupied the almost vertical sides of Nui Ba Dinh mountain and were firing directly down on the Vietnamese who were deployed in rice paddies below. Playboy 1-1 began an attack, but seeing that the Viet Cong were well dug in immediately called for the assistance of the 1-7 fire team. Making repeated passes on the sides of the mountain, 1-1 had completely expended his ammunition when 1-7 arrived. Fire team 1-7 ripped into the enemy positions immediately, using his ammunition sparingly in an attempt to sustain his attack until 1-1 could return.

While 1-1 was rearming and refueling, 1-7 was contacted by the ground troops stating that they had several wounded and requested an immediate aeromedical evacuation. Dustoff arrived just behind 1-1 and requested instructions.

CPT Childers is assigned to duty at the Bell Helicopter Company, Ft Worth, Texas.

*The 197th Aviation Company was redesignated the 334th Aviation Company (Escort).

A UH-1 arrives to evacuate a wounded soldier in Vietnam

Realizing 1-7 was low in fuel and ammunition and that the evacuation attempt was going to be extremely hot, 1-1 stated that he would perform the escort. He slid in behind the med-evac ship and turned all weapons systems to the ready position.

"Playboy 1-7 this is 1-1, maintain about a 1,000 foot orbit and place your fire directly down on the Viet Cong. I'll remain at treetop level and shoot directly into them."

The Playboys started firing as soon as they were in range. As Dustoff landed, not 50 meters from the side of the mountain, they started a left hand orbit around the defenseless aircraft. This allowed one aircraft to keep in firing position at all times.

"We are receiving heavy fire so make it snappy Dustoff," 1-1 said as a round shattered his windshield and filled the cockpit with flying plexiglass.

"Roger, we have one more patient to load," said Dustoff. "We will be ready in 30 seconds."

On the third orbit 1-1 was diverted when his wing ship was hit. As the Playboy rolled around again, 1-1 expected to see Dustoff taking off but he was still stationary.

Dustoff had found another wounded American and needed another 30 seconds.

1-1 called the fire team that was in high orbit. "1-7 this is 1-1, come on down, buddy, if you have anything left. Both my choppers have had it and we are out of bullets."

1-1 had begun to wonder about his own aircraft when he noticed a hole in the engine compartment from a head-on hit. As 1-1 swung away from the battle and headed for a forced landing area Dustoff announced it was ready to come out.

Fire team 1-7 rogered and recommended that he come out low and fast. As the flight started to climb out, they were informed that another wounded American had been found and requested Dustoff come back.

Once more the flight went back into the deadly enemy fire. This one was quick, and Dustoff took off almost as soon as he landed. Playboy 1-7 expended every bit of ammo he had left out of over 12,000 rounds.

Back on the ground at Tay Ninh, Dustoff found he had not received a single hit. Playboy 1-7 found three holes in his aircraft and both of 1-1's aircraft were down about 3 miles from the operational area, damaged beyond immediate repair. But Dustoff had the prize: two Americans with serious head wounds and three Vietnamese with severe body wounds. All five are alive today because of the teamwork and intense devotion to duty of the courageous crewmembers of the five aircraft involved.

Such mutual respect and admiration between units is what makes the United States Army unique among military organizations of the world. Someone once said, "It is not primarily a cause which makes men loyal to each other, but the loyalty of men to each other which makes a cause." Whether it be cause or loyalty, these factors will always provide the difference between victory and defeat.

Helicopter Gunnery Training in Vietnam

Colonel Raymond P. Campbell, Jr.
CO, 12th Combat Aviation Group

ON 4 OCTOBER 1966, the 12th Combat Aviation Group culminated an intensive 4 month armed helicopter gunnery refresher training program by recognizing the group "top gun" at an awards ceremony at Bien Hoa, RVN.

The requirement to deliver live gunfire support for our ground troops on VC targets in proximity to friendly troops or villages is a demanding task which the 12th Group armed helicopters do with great accuracy and effectiveness every day. Replacement gunship crews from the continental United States (CONUS) are all well trained products of the Fort Benning system. But the differences are many between targets and flying conditions found in the Vietnam conflict and on the gunnery range in Georgia. Therefore, in-country indoctrination and refresher training is a "must" after they arrive here. Old-timers, the aircraft commanders who have conducted themselves with such distinction, instruct the new crews by example and demonstration. By this means the methods of providing effective helicopter gunfire support to the ground troops which have proved so successful in the group's years of combat in Vietnam are passed along.

Setting up an aerial indoctrination and refresher training program, one which could be handled consistent with the combat mission of the units, was the first step in standardizing the gunnery techniques and crew teamwork.

This was formalized in early June 1966, and outlined a program which started at company level, proceeded through battalion level, and culminated in a group level meeting of the resulting top crews. By providing a definite goal toward which crews could train, such as group level standardization firing, we felt that greater effort toward precision in marksmanship and control of weapons would result. Companies did much of their indoctrination on their way back to home station, using the small amounts of ammunition left over from combat missions. Selected fire zones known to be inhabited only by VC, approved by U. S. and ARVN ground controllers, were used as impact areas, giving a double benefit.

During the period 15 through 22 September the assistant S-3 supervised and conducted the ground "finals" of the armed helicopter refresher and indoctrination firing. His goal was to determine effectiveness of the program, and incidentally the "top gun" from the group, by testing each assault helicopter company's best crew.

Firing took place at an approved point at a remote part of the Dong Nai River, 1/2 mile wide, about 10 miles northeast of Bien Hoa airbase, using 55-gallon barrels as point targets. The latter were selected as being intentionally very small targets for helicopter weapons. We felt that any crew trained consistently to hit a target of this small size would be able to provide more effective combat fire when called on, with significantly greater safety for friendly troops, than if bigger targets were used. Also, when sufficiently full of small 7.62 mm holes, the barrels will of course sink. The more holes in the shorter time, the sooner the barrels will sink.

Using all machineguns on the XM-16 equipped armed helicopters as well as six 2.75" rockets, the selected crews made firing passes against time in an attempt to sink their barrels. Ground rules prohibited overflying the target, going below 200 feet absolute, and flying at an airspeed less than 60 knots. Maximum time allowed, or charged, for sinking the barrel was 15 minutes. This allowed computing meaningful average times, since a complete miss on

any one run cost the competing crew only 15 minutes. That way they could remain in the running. Each crew was required to make firing runs against four separate targets, each one being dropped from 1,000 feet by the controller aircraft. Stop watch time from barrel drop to barrel sinking was the measure of crew effectiveness. No "opinion factor" could enter into this system under these rules for scoring.

Participating crews and other observers were able to observe at close range the tactics and techniques of other crews, thereby profiting from this exposure. In addition much informal exchange of information took place on the ground. For the first time proponents of the various techniques were required to demonstrate in public the good points (and in some cases the bad points) of their procedures. When the times and comments came in, the educational process was swift and effective.

Some of the general lessons we demonstrated were:

• Armed helicopter machineguns can, in fact, be used to hit and destroy point targets. This point target accuracy can be used in all armed helicopter daily operations to further ensure that no rounds will hit friendly personnel. Since we engage running VC in the open from time to time and often must fire very close to friendly units, this positive control of gunfire is vital.

• Firing machineguns into a water background graphically shows the dispersion found in each set of aircraft weapons, good or bad. The weapons, of course, are boresighted on the ground before takeoff. Check firing, or "zeroing," however, is not possible at home stations, due to their friendly surroundings. Zeroing over water in flight, therefore, is the only effective method for checking the size of shot groups of both rockets and machineguns for later correction of boresighting.

• The best crews had much better crew integrity and cooperation than the less effective crews. The pilots, for example, flew short teardrop courses, rather than long race tracks for minimum time off target. Their door gunners fired longer and more accurately. The best pilots held a steady attitude and airspeed during the firing runs to give all their gunners the best chance to find and adjust on the target.

Good preflight boresighting and weapons check by ground crews contributed materially to keeping the weapons firing. The best crews also had made several ingenious modifications in the loading of ammunition, in the feed chuting and belt drive, and in disposing of spent cases, all of which led to a material improvement in weapon effectiveness. They also found out that the M-5 boresighting telescope, when used without its 40 mm adapter, fits snugly into the flash hider of the M-60 machinegun and permits precise boresighting.

• All our units benefit from gunnery refresher training at regular periods, both to maintain a high degree of proficiency and to indoctrinate the large number of replacement crews they are receiving.

A final thought to come out of this period of training and demonstration is that the advent of the new weapons systems for the UH-1B will indeed be a blessing to gunship crews. The HueyCobra (AH-1G), when it comes, and if it lives up to its promises, should be revolutionary. We await these developments eagerly.

The idea of having a competitive armed helicopter gunnery meet along these lines in CONUS seems to have much merit. Resultant training value and competitive spirit derived would far outweigh its cost. The need for an uncomplicated, definitive scoring system in that meet seems to be a must. A particular value of such a meet would be proving or disproving the many personal notions which crews build up as to "better ways to do it," which may be different from the approved systems. Innovation is desirable but must prove itself in practice.

Times for sinking barrel, Preliminary Firing Runs:

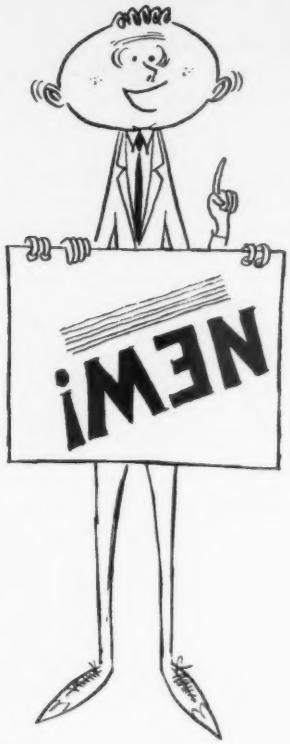
PLACE	UNIT	1ST RUN	2ND RUN	3RD RUN	4TH RUN	AVERAGE
1st	118th BANDITS	6′ 24.6″	6′ 2.6″	6′ 9.3″	2′ 44.1″	5′ 20.1″
2nd	68th MUSTANGS	15′	4′ 42.9″	4′ 1.3″	6′ 11.3″	7′ 28.9″
3rd	116th STINGERS	10′ 28.4″	6′ 3.6″	7′ 5.3″	8′ 5.6″	7′ 55.7″
4th	173rd CROSSBOWS	13′ 10.9″	11′ 20.3″	12′ 6.9″	6′ 33.4″	10′ 47.9″
5th	197th SABERS	15′	12′ 49.4″	11′ 14.0″	4′ 29.5″	10′ 52.7″
6th	128th GUNSLINGERS	15′	7′ 19.9″	—	—	11′ 9.9″
7th	162nd COPPERHEADS	15′	15′	10′ 19.6″	7′ 9.6″	11′ 52.3″
8th	A/501st FIREBIRDS	15′	15′	15′	12′ 38.4″	14′ 24.6″

Times for sinking barrel, Final Firing Runs:

PLACE	UNIT	1ST RUN	2ND RUN	AVERAGE
1st	118th BANDITS	4′ 1.8″	3′ 17.6″	3′ 39.7″
2nd	68th MUSTANGS	3′ 27.0″	4′ 11.7″	3′ 48.8″
3rd	116th STINGERS	5′ 19.2″	6′ 40.3″	5′ 58.8″

ADVERTISING

The key to selling your safety program



IT PAYS TO advertise" is an old adage. Considering all the money spent by modern merchants in publicizing their products, there must be something to this saying.

Advertising can do wonders for those who have something to sell. It causes new car and new home fever, peddles soft drinks and soft soap, and even makes a consumer want something he never knew existed before. In short, it creates a desire for a product and keeps the desire going.

Given a chance, advertising can do even better than just sell merchandise. It can and does make people contribute hard earned cash to charity, be careful about forest fires, attend church, vote for a particular candidate, be thrifty, and join the Army.

And advertising can put over your safety campaign.

Advertising is an intangible force hard to define. Most dictionaries say it's a method of "telling people about or praise, as through newspapers, radio, etc."

This suggests that advertising goes further than just a paid handbill or announcement and comprises all publicity, regardless of the form it may take. Included are news and feature stories in newspapers and on radio and TV and safety contests and suggestion programs.

To understand why advertising will help your safety program it's necessary to go all the way back to the driving forces that make humans tick. We are all influenced by motives, desires, needs, and wants. Therefore we are always seeking food and drink, rest and comfort, protection and safety, prestige and admiration, etc. Professional advertisers know that all they have to do is key a campaign to one of these and we go after their product like a hound dog after a jack rabbit.

Almost any of man's needs can be used to motivate aviation personnel but the best is "protection and safety." To sell safety to your unit, grab hold of this one and hammer away. Through it you can make safety wanted.

The media or vehicle to be used in a local safety program are many and varied, even in the limited area of an Army installation. There are bulletin boards, post newspapers, stickers, outdoor advertising, lectures, signs, cartoons, contests, slogans, and many other ways of carrying the message to the troops. To create a continuous exposure, use many of these at the same time.

Newspapers. Editors of post newspapers will help you in planning the part of the campaign to be run in their papers. Since money is seldom available for your use, you must use free publicity such as news and feature stories. The editor will write the stories if you do not feel qualified. But he will need help. You must still find the ideas and furnish the material.

Sources for ideas are unlimited. Take, for instance, the locality. Ordinarily airstrips are all the same, or at least the untrained safety propagandist thinks so. But in your area is there a dangerous hill or high ridge? You can tell everyone to look out for it and

some of them will listen to you. But make it interesting and your audience will be larger and remember longer. Write a feature story about the hill. Tell them that although it is called a hill it is actually as high as "so-and-so" mountain, that it's covered with fog so many days a year, that "ump-t-ump" number of aircraft have hit the hill, and any other interesting fact you can dig up.

Prominent and interesting aviators visiting the field make good copy, and it will help if you can get them to talk about some "hairy" experience. If they have had no accidents write a story about their many hours of flying without an accident.

Any new type aircraft visiting the area will make interesting copy that will be widely read. Bring in such safety points as speed and backwash.

Many other subjects are useable as newspaper feature articles. Don't forget safety at home, safety while driving, and safety while participating in sports.

Radio and TV. Some posts have their own radio and TV stations or arrangements with commercial stations. Ideas for radio safety programs and spot reports are about the same as for newspapers. However, ear appeal is important and stories for these media must be written differently from the newspaper story. Short, simple, easily pronounced words are best.

Outdoor. Outdoor advertising affords you the first and last chance to advertise safety to aviators. It's first because billboards can be placed at the entrance to the field. It's the last because they can be placed in such a way that the aviator sees them as he leaves to board his aircraft.

To be effective, billboards must be brief — some authorities say seven words or less and no more than one simple illustration. And make only one point. One safety officer had a very effective series of one word ads such as PREFLIGHT, GLOVES, and CHECKLIST on his last chance billboard.

A truly last chance billboard can be found at an airstrip in Korea. At the end of the runway are two hills. Several aircraft didn't get off the ground in time and hit these hills. A billboard has been placed at the end of the runway just outside the fence. It says "That's All Brother."

Transportation. If there is a bus or regularly assigned automobile that goes from the main post to the airfield, or perhaps regularly assigned transportation from operations to the aircraft, you have the opportunity to advertise safety through "transportation advertising."

Transportation advertising can be either indoor or outdoor. Indoor is placed inside the automobile, bus, or truck. Outdoor is hung on the side or the back of the vehicle.

These two types of advertising have advantages you can use. For instance, your indoor ad will catch the aviator while he is in a relatively relaxed and impressionable mood. Outdoor transportation advertising is able to reach out to those not in the vehicle. Both afford you repetition and give you another chance at the aviator.

Outdoor transportation advertising should be treated like regular outdoor advertising. Since it is moving about, it will usually be seen only for a split second. Therefore the message must be short and the layout simple.

Indoor transportation advertisements can say more, with messages running up to 36 words. The layout must be simple or it conflicts with the mood of the reader.

Overcrowded bulletin boards (left) fail to make your point. A single display (right) is much more effective

Telephone Directories. Post telephone directories don't usually run paid advertising. A safety ad run in this media will have no competition and will therefore have great appeal. The front cover is the prime spot but a full page somewhere inside is almost as good. Another good idea is to use little box ads scattered throughout the directory. These are best if placed at strategic spots, such as by the telephone number of operations, post taxi, and the airfield.

While we are talking about telephones, don't forget the telephone dial or the cradle under the telephone receiver. These are good places for a one or two word safety message.

Bulletin Boards. Bulletin boards are old standbys for safety officers and are very effective when properly used. Unfortunately they are often neglected and their effectiveness ruined.

Have at least two bulletin boards — one where aviators concentrate and the other where maintenance people can see it. What safety information you post is limited only by your ingenuity and initiative.

Don't let the material on your board become stale. Nothing should be left for more than a few days. When the impact has been made, take it down and replace it with something else.

And for goodness' sake don't let your boards become overcrowded! Nothing drives people away faster than a board full of papers, all crying for their attention (and none of them getting it).

A refreshing treatment is to use the board as a single display, treating the whole thing as one poster. Another innovation is to convert your bulletin board into a display window with glass in front and a stage in back. Back lighting makes it very effective. Your imagination can really run wild here.

Many techniques are involved in decorating bulletin boards and window displays, and many books have been written on the subject. Your local library can furnish you with these. If you have no money or no professional draftsman to help you, don't feel that you can't do this sort of thing. In this day when everything must be professional looking, a rough unprofessional but interesting display has good drawing appeal. Use cutouts from magazines for your illustrations. Letter your headlines by hand and don't worry if they are not perfect — just as long as they are neat and have a good message.

Posters. One of the best methods of getting short safety messages across is through safety posters. They can be placed in key spots, such as on a door leading to the field, on the wall by the operations counter, and other convenient places. Or they can be used on your bulletin boards. Posters allow you to make a definite point at a definite time and in a definite place. At the entrance to the snack bar you can advise the eating of a balanced meal before a flight. At the entrance to the tool room you can advise the mechanics to "use a torque wrench."

If you can't find the right poster to drive home a point, construct your own. And again keep your posters fresh. Remove them regularly. Save them for later on; don't throw them away.

Many other ways abound to advertise safety around your airstrip. Stencil on toolboxes the advice "Count your tools." On clocks place the advice "It's time to practice safety." On the bottom of those glass paperweights remind the aviator to "Watch your weight."

One or two words of caution: You can overuse the word "safety" until it becomes obnoxious. Sell your product by occasionally referring to it as "education," "professionalism," or "pilot know-how."

Also don't overuse the number of media in any one campaign. Advertising men know that it is possible to advertise a product so much that the effectiveness is lost. Use only enough of each of your vehicles to cover areas not covered by some other vehicle. Save the rest for use later on.

Sometimes it's a good idea to tie them all together. For instance, in summer one whole campaign can be on thunderstorms. In winter another campaign can be about the dangers of cold weather flying.

Remember everyone is interested in their own safety. You should not have to sell them on this. But you do have to sell them on the idea of operating in a safe manner for their own safety. Remind them of the many little things that make for a safe operation. Keep your advertising current, interesting, and in good taste and much of your safety battle will be won.

How many TIME International readers in business have a direct hand in company purchases?

6 out of 10.

Most of TIME's readers in business are at the executive and management levels—men who determine policy and purchases. Almost two-thirds of them are either directly responsible for, or are consulted on, company buying decisions. As businessmen and as family men, these TIME International readers exert influence and buying power vastly out of proportion to their numbers. To them, TIME Magazine's weekly evaluations of world business and of world affairs are a necessity. To you, TIME is equally necessary in any selective marketing plan—in any world market. *Talk to the right people in the right place . . . in TIME.*

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FOR SAFETY SAKE

HORSES

DON'T ALWAYS HAVE TO BE "PRE-RODE,"

BUT

YOU MUST PRE-FLIGHT A

HELICOPTER

Cutouts from magazines can be turned into excellent safety posters. For example, a magazine ad (upper left) is converted into a preflight safety poster (upper right). Below, an illustration from a magazine makes a safety point out of the annual physical.

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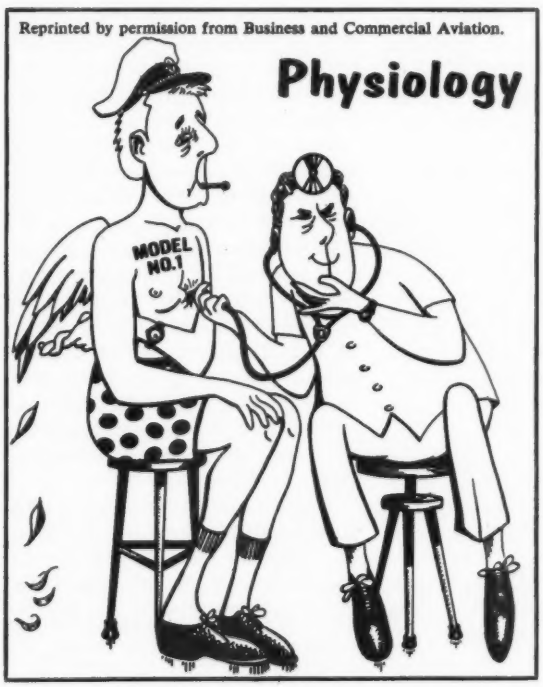

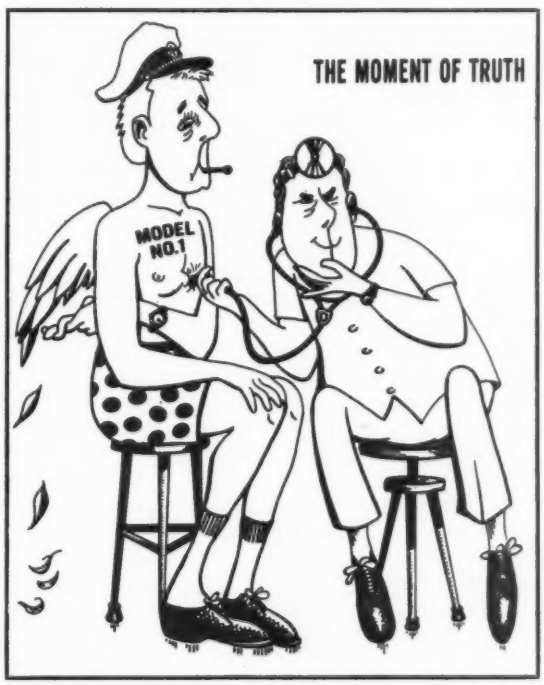

When Is It A Formation?

Major Charles C. Frank

VISUALIZE, if you will, a flight of UH-1 aircraft departing Lawson AAF with 1-minute separations between aircraft. The flight leader listed all five aircraft on his flight plan, and they are departing according to his instructions. The aircraft are to maintain 90 knots airspeed.

Twenty minutes later, the flight leader breaks the radio silence with instructions to the aircraft commanders to increase airspeed to 100 knots and slowly close on him, forming a V formation.

At what point during this flight will this group of aircraft become engaged in formation flight and thus subject to the restrictions and prior requirements that are imposed by regulations controlling formation flight?

Army Regulation 95-2 defines formation flight as: "Two or more aircraft flying in proximity to each other under the direction of a designated flight leader." From this definition it is apparent that we must have a flight leader, at least one follower, and that they fly in proximity to each other.

But what is proximity? Webster, the Ann Landers of the spoken word, defines it as the state or quality of being near; nearness in space, time, etc. This only makes matters worse than ever, for what is near when you refer to space and time? Webster again offers us inspiration by defining "near" as: closely, intimately; and, close in distance or time; not far.

We all concede that two UH-1 aircraft separated by two rotor diameters are "near." But what about the 1½ mile separations between the aircraft departing Lawson AAF?

The key to this puzzle must be somewhere other than in the definition of space and time. Specifically, the criteria for formation flight must depend on the relationship between the leader and the followers. We must temper our thinking between the Air Corps B-17s depicted in "12 O'Clock High" and the typical UH-1 mission that might start out, as in the example above, where the formation flight commenced with the pull of the pitch.

To establish a common basis for thinking in the 10th Aviation Group, we have applied our own definition, which is:

"One or more aircraft which maintain a station on the lead aircraft under the direction of a designated flight leader, regardless of the physical separation between aircraft, are engaged in formation flight."

Webster supports us in the selection of "station," which he defines as "The place where an . . . [aircraft] is located, especially an assigned . . . position or location. . . ." If the first aircraft leads the second from takeoff to destination, and controls the actions of both, even though the station is simply behind, in front of, or above or below, this flight of two is maintaining a formation.

You may be wondering why so much effort is being expended in pinning down a "formation." The obvious answer might be to maintain legality and avoid violations which stem from misinterpretations. A good soldier will do what is right if he knows what is expected of him. But a more important reason is to emphasize that designated flight leaders must be fully cognizant of the responsibilities that are being placed on their shoulders.

Single sortie flight preparations are basically an exercise of a mental checklist for the aviator. In his mind he checks off maps, flash-

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Many formations begin with the pulling of the pitch

light, route, helmet, weather, -13 scan to ensure radios he will need are operational, and so on. This flight preparation may be accomplished without utterance of a single word.

When four more aircraft are added to this aviator's flight plan, with him in charge, he must scan AR 95-2, and in the case of Third Army personnel, TUSA Reg 95-4. The requirements for formation flight are extracted below:

AR 95-2: . . . Before takeoff the aviator in command will—

(1) Insure that each pilot is qualified and proficient in formation flight techniques.

(2) Brief each pilot on the weather, flight plan, and other pertinent information (including flight altitude).

(3) Insure that each pilot is in possession of necessary maps and charts.

(4) Assure that each pilot holds the required instrument pilot certificate if any portion of the flight is to be conducted under IFR.

(5) Certify in the "remarks" section of DD Form 175 or FAA Form AGA-398 that the above items have been accomplished.

Third US Army Regulation 95-4, to the above list of requirements, adds:

(1) Positive voice communication exists between all aircraft of the mission.

(2) Each aviator understands and is proficient in the procedures for changing or breaking formation.

(3) The troops to be transported are informed on emergency procedures in event of accident (include smoking, belts, seating, placement of loose items).

After reading the requirements of AR 95-2 it becomes evident that they are basically the same items the aviator on the single sortie mentally considers, with the exception of the notation on the remarks section of the flight plan. The significant factor is that the flight leader must assemble the other aviators and exercise the checklist orally. In addition, he must be satisfied that his aviators are trained in formation flying and that all have a common understanding on changing positions or breaking formation, especially if the leader or inside men lose radio communications.

A straight-forward flight of aircraft that begins as the Lawson departees did, with every intent to maintain wide separations, often tightens up due to mission changes, weather, darkness, or simply the tendency to bunch up due to poor flight discipline. Thorough preparations initially, which would be required for all multi-aircraft flights, by our definitions, will insure preparedness for the unexpected, which only too often must be expected.

THUNDERSTORMS
--- Do Something About Them

THE BEST THING to do about thunderstorms is – stay out of them! This is obvious, but not always possible. So the next best thing an aviator can do is to study all that's available concerning thunderstorm cause and behavior.

Cloud formation requires these atmospheric conditions: unstable air, a lifting action, and high moisture content. Other cloud formations require this three-way situation, but the thundercloud needs it in a greater degree.

It is not always possible to recognize a thunderstorm. From a distance it may look like a tall cumulus cloud, or a mass of surrounding clouds may disguise it. When one can see a thunderstorm clearly, however, it does have certain characteristics to help identify it.

As the thundercloud builds itself upward, it forms puffy, rolled-looking sides. When it extends upward to great heights it is known as towering cumulus. Through growth and change, its top spreads out in an anvil shape. Below it, this anvil seems to be a solid, horizontal cloud stretching out in front of the storm. Direction of the storm movement is shown by the direction of this horizontal anvil, since these high clouds are pushed out by the upper winds.

Here is the enemy—busy growing to killer size

An ominous clue to watch for is the "squall cloud," or "roll cloud," which extends downward from the main base of the thunderstorm. This turbulent cloud is along the front and at the bottom of a violent thunderstorm. It means there is plenty rough weather within the storm whenever this cloud appears.

Agitation between a strong downdraft coming out of the storm and a swiftly rising air current at the leading edge of the storm causes the roll cloud. Below the storm cloud, winds are gusty and strong. They are usually blowing up and into the storm from the front and down and out of the storm behind the roll cloud. These winds precede heavy rain.

Getting too close to the roll cloud may result in the aircraft's hurtling into the storm itself. It's possible not to see it in time, as the tricky roll cloud may be hiding behind other clouds surrounding the storm.

In considering thunderstorms generally, it would be a hazardous choice to try flying under one, particularly in mountainous country. Under the roll cloud such sudden changes in wind direction, strength, speed – or abrupt gusting – can easily result in a pilot's

Thunderstorms mean business—and so should you. Respect and study their dispositions

loss of control. Obviously, a landing or takeoff under such conditions would be quite dangerous. If possible, such a takeoff should be postponed, and a landing made at some airport other than the one with such conditions.

Most thunderstorms occur over continents during summer months and daylight hours. This is fortunate, since pilots can see and avoid flying into the towering cumulus clouds associated with them.

Radar, of course, can give a pilot the picture ahead when he checks weather. However, it should be remembered that even the clear air outside the clouds can contain severe turbulence — and radar can't detect that.

Wide thundercloud formations should be avoided by a distance of 20 miles, if possible, and small ones, which usually produce little turbulence outside the clouds, by 5 miles.

Clouds can grow quite rapidly, often going as high as 60,000 feet. Since it would not be feasible to top them, the aviator will have to fly around them.

It is important for an aviator to report any air turbulence, keeping in mind that even if you have a report of light turbulence ahead, the situation could have changed quickly since the previous pilot reported it.

How does a thunderstorm get all that turbulence, anyway? Well, a thunderstorm is made up of one or more units of convective circulation called "cells," which are constantly changing. These cells may dissipate or develop as units, distinct from adjacent cells. They develop through three stages. These are the growing stage, with all the air rising — and this rising air can reach the velocity of 60 knots — the mature stage, in which the currents both rise and descend, and the anvil stage, mentioned before. This last stage has weak downdrafts through the cell.

Depending upon their stage of development, thunderstorms cells, in their horizontal, oblong formation, can extend from 1 to 5 miles in diameter and as high as 67,000 feet.

As the thunderstorm continues, new cells build as the old ones die out, and each cell's "life" is independent. This "life" is fairly short, usually less than one hour. The time of greatest turbulence in a particular cell is at the end

of the growing stage and the beginning of the peak or mature stage. Cell turbulence is usually least below 10,000 feet, and heaviest between 14,000 and 20,000 feet.

Maintaining a given flight attitude during heavy turbulence must be attempted with great caution. A diving attitude increases wing stress. The possibility of stalling is increased by a climbing attitude. It is preferable to use recommended power settings in turbulent flight and maintain attitude by the attitude gyro rather than correct for immediate changes in altitude.

When thunderstorms are associated with a cold front, the storms may be organized in long bands and progress ahead of the front. These are called squall line thunderstorms. They may extend horizontally for a hundred or more miles, and vertically to heights of 60,000 feet or more.

But sometimes a thunderstorm does not follow that pattern. The updraft and cloud formation will tilt with the wind. Clear air under a tilted thundercloud, or between thunderclouds slanting toward each other, must be avoided. Hail or turbulence may be found in these areas.

With thunderstorms comes lightning. While it may be more disconcerting than dangerous, it is a factor with which to reckon. The metallic structure of aircraft acts as an electrostatic screen, and deflects the currents around the plane's occupants, which is some comfort. However, a strike can result in burning small holes in the surface skin or rudders, elevators and wing tips. It can also burn off radio antennas or other protrusions.

The danger of sudden, momentary blindness after being exposed to a flash of lightning at night can be of serious consequence. Wise pilots turn up the rheostats on the cockpit lights, and fly by using one eye while keeping the other closed. Others put on dark glasses and avoid looking out when flying in thunderstorms.

The phenomenon of static electricity, or "St. Elmo's Fire," can add to the concern of an aviator flying in a thunderstorm area. When "St. Elmo's Fire" appears, and static builds up rapidly in the radio, there is a much greater chance of the plane's being struck by lightning. The temperature range usually associated with this condition is somewhere between −25° C and +2° C.

It is important to understand the effect of static electricity on radio equipment. Though it has little or no effect upon VHF and UHF, such navigational aids as nondirectional beacons (NDB) must be used with extreme caution due to the fluctuating or erroneous indications that occur.

Icing and hail are two more hazards that can be associated with thunderstorms. Icing can be very dangerous. Even if the aircraft has deicing or anti-icing equipment, the pilot must get out of the area as soon as possible.

As to hail, as yet no reliable method has evolved for recognizing or forecasting a storm that will produce hail. It is probably best to assume that hail will be in the thunderstorm at some place, at some time. Although hail encounters are usually of short duration, damage to the aircraft can be severe.

It pays to be prepared for everything — turbulence, rain, hail, snow, icing and lightning — when in a thunderstorm. As was observed earlier, the main thing is not to enter it. But if you find yourself in the middle of a tough spot, maintain your original heading — and *don't* make any turns.

The way straight ahead is usually the quickest way out. And that's what you'll be interested in finding.

At night bright lightning flashes can blind an aviator

My Friend Future and His Chariot

CW3 Valentine Hampton

The author presents his views on what a fighter helicopter should be. The drawings of the fighter helicopter contained in this article were made from a model designed by the author. It is in no way intended to resemble any aircraft in existence.

IT WAS LATE fall of 1963 when I got to know Future. He was a young, energetic captain with a determined look in his eyes.

We had met at one of the southwestern airports while on a cross-country RON stop. Since neither of us had ever been in that city before, we decided to sample some southwestern hospitality. Soon we found ourselves in the common meeting place of all aviators.

The subject of discussion, without exception at first, was centered on the opposite sex. However, as the tension relieving liquid began to take effect, it changed to flying and flying machines.

It was then that I first heard about the FH-1 (fighter helicopter). The whole thing sounded fantastic as Future described this new breed of helicopter. He even promised to show it to me the next morning.

Unfortunately, the next thing I recall was the feel of a wet towel over my face as my faithful co-pilot and crewchief desperately attempted to awaken me about noon the following day.

After expressing my dissatisfaction for such uncivilized treatment, I inquired about Future, but neither knew anything of him. Future was gone just as unexpectedly as he had come. However, I could not forget the story he told me about the FH-1. Since, I have traveled wide and far in search of the FH-1, but always with negative results until one day in Vietnam.

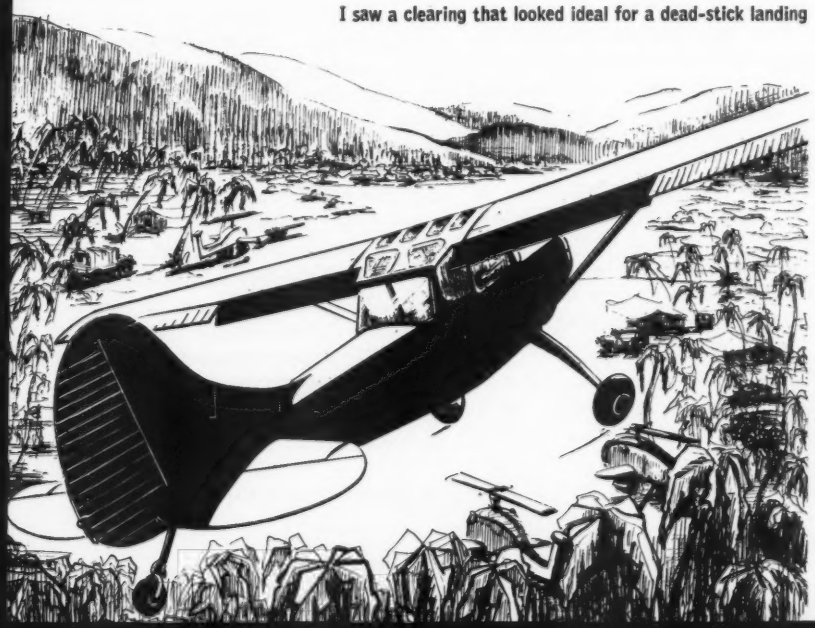
It was a hot, humid early summer day over the jungle when I was jolted by an unexpected sputter of my Bird Dog's engine. This was followed by a total absence of that familiar humm. After quickly checking the fuel, ignition and boost pump, I attempted to restart the engine. The only response was an occasional backfire.

After turning off the fuel and all but emergency radio switches, I checked my parachute harness. Then I saw a clearing in the jungle which looked ideal for a dead-stick landing.

As I neared the clearing on final, I saw tents, vehicles, and what at first appeared to be ordinary helicopters on both sides of the clearing along the edge of the jungle.

After my Bird Dog slowed

I saw a clearing that looked ideal for a dead-stick landing



CW3 Hampton is now serving in Vietnam.

My Friend Future and His Chariot

down on ground roll, I turned from the clearing and let the aircraft roll to a stop under cover of giant trees, alongside one of the helicopters.

I noticed that these helicopters were strange. I had never seen such helicopters. Yet, all had U.S. ARMY markings.

I sat there, wondering about the whole thing, when I was interrupted by a young sergeant, "Welcome to the 25th Aerial Artillery, sir. Our operation is only a few yards from here. I suppose you would want to get in touch with your unit."

"Yes, yes thanks. I better do that," I replied as I was getting out of the Bird Dog without letting my sight wander from the strange helicopters.

"What are they?" I asked my escort.

"They are 'Chariots', sir," replied the sergeant as he looked at me with surprise.

"Chariots, Chariots," I kept mumbling to myself as we approached the tent.

The sergeant pulled the mosquito screen aside and let me pass him into the tent. I ducked my head as I went in. As I straightened, I saw my friend Future standing in front of me with a broad smile on his face.

He hadn't changed in appearance since I saw him last, except that he was a major now. "What's the idea, sneaking in like this without a flight plan or power?" he said jokingly.

By this time I accepted the whole thing as reality and threw what I felt at the time was a humorous reply. "Just thought I'd come up to see the FH-1 which you promised to show me three years ago."

Future squinted his eyes and said with a smile, "As I recall, I told you that FH-1 stands for fighter helicopter. But we decided to name our helicopter 'Chariot.' We feel it sounds better and is more appropriate. Now, if you're ready, I will give you a grand tour of the Chariot."

No sooner had he said this than I was already out the door.

As Future led me to the nearest Chariot, he proceeded to describe it. "This is the Chariot, twin turbine, single seater, 18,000 pounds of gross terror. It is highly maneuverable at all speeds up to 170 knots, and handles like the best of sports cars."

It was an impressive sight. There was a narrow cockpit with a single piece canopy which had no obstruction to vision. This cockpit sat on a dual wheel nose landing gear. In front of the nose landing gear was a spherical machinegun turret. I noticed that the machinegun had five barrels – a minigun type. I said, "Where do you have room for ammunition for a weapon with such a high rate of fire?"

"No problem," answered Future. "This machinegun is designed to use only projectiles and a solid form of propellant, which of course eliminates the weight and bulkiness of cartridges and ammunition belt links. This allows us to carry 20,000 rounds of projectiles and propellant which comes prepacked in disposable containers specifically designed for the Chariot. Each container holds 2,000 rounds of projectiles and propellant. There is a compartment holding five containers on each side of the aft section of the cockpit. From here the projectiles and propellant are fed by gravity to the receiving chambers of the machinegun. The machinegun is electrically driven and can be set to fire at any rate from one to 5,000 rounds per minute."

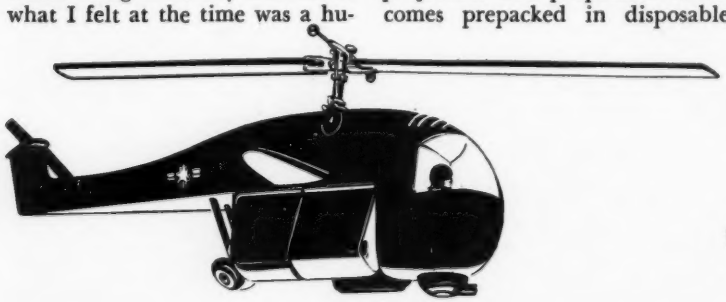
"Do you have any problems with misfire?" I asked.

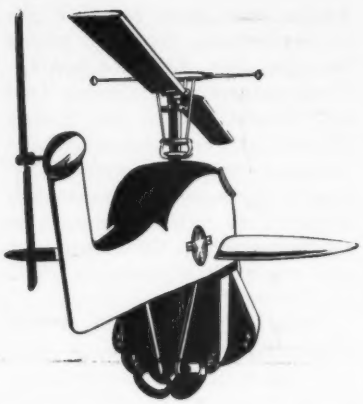
"So far none has come to my attention. You see this machinegun is designed so that very little can go wrong with it. The receiving chambers and barrels are mounted on a rotating drum. As the drum rotates, it brings the receiving chamber of each barrel under a chute which delivers a projectile and propellant to their respective chambers, which are connected by a narrow gas port. As the drum rotates to the three o'clock position, the propellant is ignited by a high tension electrical spark, and the projectile is fired. In the event of misfire, the projectile and propellant continue to rotate to the 6 o'clock position where they simply fall out of the receiving chamber. In event of a jam that chamber simply refuses to accept a new projectile and the machinegun continues to fire only four barrels."

"Fantastic," I remarked.

"Well, this is not really a new idea. However, when it was first conceived, there was no method of producing anything like this. So the whole thing was labeled as impossible and forgotten until a young gunsmith defied the experts' opinion. Now it works like a clock. The pilot can control this gun 60° vertically and 120° laterally, which is more than adequate for the Chariot's speed.

"Here, aft of the cockpit, suspended under the fuselage we





have two rocket pods. Each of these pods is made up of two sections which are hinged at the top, clamshell type. Within each section is a continuous belt transporter upon which are mounted the rocket tubes. Each belt transporter will accommodate twenty-five 4.5" rocket tubes or twenty 5" rocket tubes. This means that the pilot has at his disposal either one hundred 4.5" rockets or eighty 5" rockets, or he can carry one pod of each.

"The pilot can select whatever pod he wishes. Whenever the system is armed, the selected pod swings open at the bottom, placing two firing tubes of each section outboard of the helicopter frontal profile. The pilot can fire from one to four rockets at a time, with four seconds interval between firing. As soon as the rockets have been fired, the transporter mechanism automatically brings new rockets into the firing position.

"By the way, these rockets come in various types—fragmentary, armor piercing, phosphorus and chemical. The pilot can select any of these types for a specific target, or he can fire at random on large concentrations of troops and equipment. Of course these pods are jettisonable. For rearming, we simply remove the empty pods and replace them with loaded pods. Besides these we can also carry one large pod with six heavier rockets."

"Don't you think this is a rather expensive piece of artillery?" I asked my host.

"If it were only an aerial artillery piece, it probably would have been somewhat expensive," replied Future. "However in the case of Chariot, I must say that this is the first helicopter in the Army's history which gives every dollar's worth of performance. The Chariot is used not only as an aerial weapons platform but also as a work horse. It carries external loads up to 8,000 pounds; it carries chemical spray tanks, wire laying pods, and just about anything other than troops. However, the real savings to the Army comes through the use of Chariot's sister ship.

"You see there across the clearing?" and he pointed to a helicopter in the shadows of the jungle across the landing strip. "Every major component on that helicopter is exactly the same as on the Chariot. The only difference between them is that the sister ship is specifically designed as a troop carrying helicopter, and it will carry 28 fully equipped troops. Do you realize to what extent this minimizes and simplifies our logistic support? We use the same major components, same tools, same maintenance personnel, and even in some cases, the same pilots.

"Well, let us get back to the main subject," said Future as he proceeded to describe the Chariot.

"The engines are mounted on the upper deck, which is called the powertrain deck. Under the powertrain deck we have fuel tanks that give us nearly 3 hours of endurance. All this, including the pilot compartment, is protected by armor, which is probably somewhat different from what you have seen. We call it 'fish scale.' It is made up of individual saucer-shaped pieces of steel mounted in such a way that they overlap each other just like fish scales. The theory is that a projectile fired from any angle will ricochet at an 80 to 1 ratio rather than penetrate this type of armor. It is also much lighter than solid armor plates."

By this time we were on the other side of Chariot. "This tricycle landing gear is retractable," continued Future. "The main gear folds under the fuselage and to the rear of the aft pod, while the nose landing gear is retracted into a well under the cockpit."

"How about the wings?" I asked Future as we came to short stubby wings, which were no more than 8 feet in length.

"Oh yes," replied Future. "These wings are not rigidly mounted. They are connected through push-pull rods to the longitudinal cyclic controls. In forward flight at speeds upward of 70 knots they unload the rotor system up to 20 percent, which allows us to attain speeds up to 170 knots without getting into a retreating blade stall. At forward speeds over 70 knots, the angle of attack on the left wing is increased by movement of the cyclic stick. This produces more lift on the left side, allowing us to reduce the angle of attack on retreating

blade. It is quite simple.

"Well, let me show you the cockpit," Future said as he opened the canopy by pulling it forward on the tracks.

I climbed into the cockpit which was very comfortable and to my surprise not excessively cramped with unnecessary equipment. Everything was within easy reach. Immediately to the left of the pilot seat was the circuit breaker panel; on top of it on a 45° incline was the armament control panel. On the left side of the instrument panel were engine and transmission instruments, and immediately below them was the engine starting and fuel control panel. In the center of the instrument panel were flight and navigation instruments and below them the caution light panel. All navigation radio receivers were mounted on the right side of the instrument panel while communication equipment control panels were mounted on a 45° inclined quadrant to the right of pilot seat.

"This cockpit is made up of six separate, individually replaceable units. When you remove the canopy, you can unbutton the entire cockpit in three sections. This approach greatly simplifies maintenance and reduces down time due to maintenance. For example, in event of battle damage to any of these components, the entire unit can be replaced.

"Many times our Chariots come back from a mission with damage which would keep an ordinary helicopter out of commission for weeks or months. With this new approach toward simplified forward area maintenance, our Chariots can go out on a mission in topnotch condition, repaired by the time they are serviced with fuel and armament. Of course we are not doing this for minor repairs which can be accomplished in less time than replacement of a complete unit.

"Now, let me start on the inside. On the left quadrant you see the machinegun control panel, and to the right of it the rocket system control panel. The machinegun control panel is relatively simple. It has only the arming switch and a rate of fire selector knob. When the pilot places the machinegun arming switch into the 'armed' position he energizes all circuits in the machinegun system provided that the rocket system is not in use. You see, the rocket system overrides the machinegun system, because some of the electrical circuits are used by both. I will explain this as we go on.

"Anyway, once the system has been placed into the 'armed' position, the pilot uses the thumb switch on top of the cyclic stick to control the machinegun movement vertically and laterally, and the trigger on cyclic stick grip to activate the firing mechanism.

"Of course we have a number of safety features built into the armament system. First of all, we have a large illuminated sign in front of the pilot on the upper portion of the instrument panel, telling him which one of the two systems is armed. Then we have an automatic attitude limiter which automatically disarms the weapon system whenever the pitch attitude of the helicopter changes more than 10°. Also, we have the time limiter, which works something like this. A timer begins counting the moment the pilot pulls takeoff power at the start of a mission. When the pilot activates his weapons, the timer automatically notes the time lapsed since the start of the mission (say 20 minutes). It then sets itself to disarm the guns in half the amount of time lapsed to ensure that the pilot does not inadvertently return to his home field with armed systems. So, if after 20 minutes from takeoff the pilot arms his weapons, he would know that they would be automatically disarmed 10 minutes later. If he needs more than 10 minutes, he can rearm the weapons in a split second."

"How about the aiming of the machinegun?" I asked.

"Well, this is the only primitive method we have on our Chariot, and we are definitely convinced that it is the best of anything that we have tried. The aiming system for the machinegun is relatively simple. From the lateral azimuth traversing mechanism of the turret, we have mechanical linkage to a vertical shaft, which extends through the cockpit floor, behind and above the instrument panel. On top of this shaft, right over the dashboard, or the instrument panel visor as you would call it, we have a simple arrow which always points in the same direction the machinegun is pointing. As you can see, from where the pilot is sitting, regardless as to direction into which this arrow is pointing, it is always aligned so that without moving his head the pilot can see along the line formed by the arrow.

"We do not have an aiming device for elevation. However, we have a tracer projectile spaced every eleventh round. This gives us a tracer for each barrel every 55 rounds, and this we found to be quite effective in bringing the fire on target. For the rocket system, however, one needs a good sight. Now, here we have the rocket system control panel, which includes a two position arming switch, marked 'armed fore' and 'armed aft.' The function of this switch is to select either of the two pods and to activate all elec-

trical circuits of the selected system.

"Next is this five position knob-type switch which is marked 'armr,' 'frag,' 'phsp,' 'chem,' and 'all.' This switch is to select the type of rockets the pilot desires to use on a particular target. When one should run in on a heavy concentration of troops and equipment, then he simply places this switch into 'all' position and spits four rockets every four seconds. Here we have another four position knob switch marked from one to four. This switch is to select the number of rockets that the pilot wants to fire in salvos. Of course, whenever the type selector switch is in 'all' position, the system will fire four rockets regardless of the position of this switch.

"And now we are at the heart of the whole system," Future said as he reached up and pulled down a small box which was about 8" high, 5" wide and about 5" in depth, with a 4 by 4 inch plate of glass through which one could see everything in front of the helicopter. The glass was bisected vertically and horizontally by hairlines that formed a cross right in the center. This box was suspended on two curved rods which conformed to the curvature of canopy and were attached in back of the cockpit over the pilot's head.

"This is the rocket sight. The whole system is relatively simple. It consists of a radar unit (which is located in the forward section of the cockpit and is similar to that used in radar altimeters) radar locking gyros, an attitude reference gyro, programming computer, and finally, this display box or sight. When you place the selector switch on the control panel into either 'fore' or 'aft' position, you activate all electrical circuits of that system, including the sight system. In other

words, you placed everything on standby. Then as you pull down this sight, you have overriden the machinegun system. The thumb switch now controls the radar disc positioning mechanism rather than machinegun traversing and elevation, and the trigger is used for firing rockets rather than the machinegun. At the same time you have extended the selected pod. Actually you could fire rockets right now. If you had to place a barrage fire on a good size area, you probably would do so by looking through the glass plate and roughly aligning the right center on the center of target area. However, if you were tackling a small target such as a gun emplacement, a vehicle or a pillbox, and if you wanted to score a hit on the first go, then you would do as follows.

"As you pull down this box, you have also activated the radar antenna. You look through this sight and align the cross formed by the hairlines with the target by maneuvering the helicopter. Then you would see a red lighted dot somewhere in the glass; this represents the radar disc antenna. As you keep the hairline cross on the target, you bring the radar disc also right over the cross by manipulating the thumb switch. Once you have it there, you press the red button which is to the right of the thumb switch. In doing so you have locked the radar on target, and at the same time a blue dot circle appears somewhere in the glass plate. This is your sight. Now all you have to do is to align this sight with the target and the crossed hairline in the sight, and fire away.

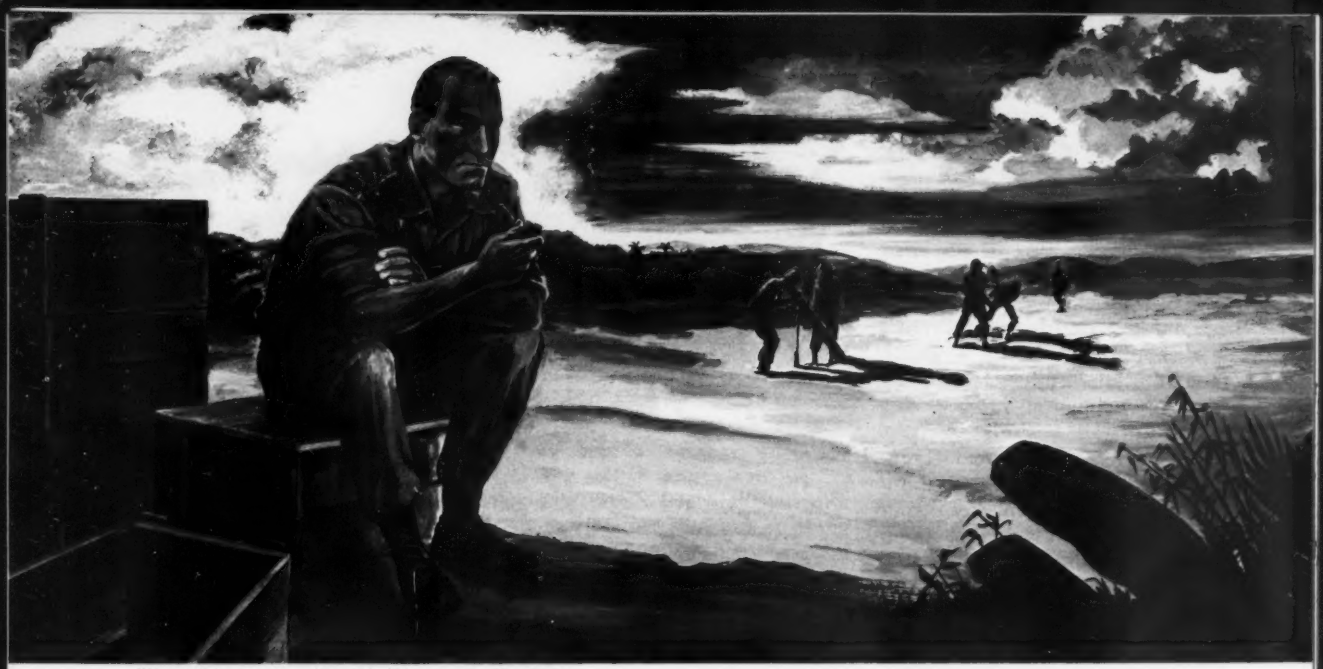
"Now let me go over this in different terms. When you have aligned and locked the radar on target, you have locked it in space by locking gyros. From that moment the radar is pointed on target and feeds into a computer the distance from the target and the rate of closure. The attitude reference gyro also feeds into the computer the relative angle at which the helicopter is at all times in relation to the base line from the target. The computer combines data received from the radar and reference gyro and provides a continuously changing triangulation which is represented in the sight as a blue lighted dot."

"This is amazing," I said. "Of all the complicated things nowadays, it is beyond my comprehension as to how anyone could come up with such a simple and yet such an outstanding combination of systems and put them into one thing called Chariot."

"All it takes is someone named Future," replied my friend as he smiled.

"Doggone you guys. When will you get civilized and start using some means other than wet towels to awaken me?

"By the way, was Major Future trying to get in touch with me?"



Ghost Weber contemplates his future in the Far East

Clouds Over Soon Lon Valley

Captain Robert S. Fairweather, Jr.

The CO chose Ghost for the mission because he had a lot of confidence in his ability . . . especially in the soup.

THE SETTING SUN lent its last glory to the fiery orange cumulus puffs on the horizon as the shadows of dark finally captured Soon Lon Valley. The busy sounds of daytime had long become hushed and the only sounds now heard were the subtle noises of people preparing for sleep, punctuated occasionally by the barking of dogs or the swearing of men tripped by misplaced equipment.

Ghost Weber hardly noticed the passing day as he sat on the pile of empty ammo boxes, lazily puffing away on a pipe that had seen better times. His thoughts were in another world, a world inhabited by dream people who were once very real to him, but who now existed only in letters and photographs.

Ghost was not his real name. It was just a name he had gained from a previous escapade. Three days after being assumed dead in an air crash, he had walked into the camp, bedraggled, but alive. Actually, the U. S. Army knew him as George P. Weber, CW3, Army Aviator. A tall, sparse man of 39 years, he walked with the spring of a young athlete, but his aged showed in the hard set of his bronze tanned face.

The approaching GI shook Ghost out of his reverie.

"Sir, the Old Man wants to see you in the tent," squeaked the young PFC.

As he slowly rose to his feet and returned the salute Ghost thought, Was I that young once?

The CO's tent still held the warmth of day because it was closed to prevent the escape of any light. Although the area was secure, there was always the possibility of a sharp sniper finding a target.

Relaxing at the field desk was Major Arlen, the "Old Man." A sharp professional officer, he looked younger than his 36 years. Only the blue-black pouches under his eyes belied the strain of command. In the other chair sat Captain Burns, the operations officer.

"Ghost," said Major Arlen,

CPT Fairweather is now serving in Vietnam.

The fuel warning light blinked on

after returning the salute, "I have a job for you and Mr. Carter, who will be here in a few minutes. We are expecting IFR conditions tomorrow but have to resupply a special forces detachment and pick up a litter patient. We would do it tonight except that the detachment requested that we give them 6 to 8 hours to secure a landing site. Captain Burns will fill you in on the details." Saying that, the CO got up and departed the tent.

"Go ahead and light up," said Captain Burns. "Carter should be here in a minute. The reason the CO chose you for this mission is that he has a lot of confidence in your ability, especially in the soup. You might think that Carter, being fresh out of flight school, is an odd choice for a copilot. However, he is a good pilot and did well in his tactical instrument training at Rucker. I figured that he might be more help than some of these strictly VFR oldtimers around here."

Warrant Officer Carter came through the tent flap as if on cue. He looked every bit of nineteen, but exuded a confidence typical to a person who had proved that he could hold up under fire.

Carter didn't get a chance to salute or report because Captain Burns was already beckoning him to take a seat. Not one to waste words, he got right to the point.

"Gentlemen, the detachment is located here at coordinates 405361. As you will notice, it is quite near the border and, for security reasons, I can't tell you the nature of its mission. Your mission will be to resupply the detachment with ammunition and bring back a litter patient. They will be expecting you between 0850 and 0915 hours. The big catch, though, is that the forecast for tomorrow morning is probably IFR. Ceiling will be 200 to 300 overcast to broken with 1/2 to 1 mile visibility. Knowing this, we have already had a tactical nondirectional beacon dropped into the camp. The frequency is 341.0 and the identifier is 'XUC.' Here are the applicable SOIs. Any questions, gentlemen?"

Neither Ghost nor Carter spoke.

"Sergeant Packard will have the chopper loaded by 0600. He will be your crewchief. The aircraft will be 9163, our best instrument ship. I wish I could give you more details on the tactical situation, but you know as much about it as I do. The mission is important but nothing will be said if you have to abort. Good luck!" So saying, Captain Burns dug into the paperwork that somehow becomes a part of combat.

Much flight planning was conducted in the mess tent, partly due to the tables and light, but mostly due to Sergeant Pendergast's always available coffee and cookies. Ghost and Carter laid out the tactical map under one of the bare light bulbs and spread pencils, paper and a map plotter along one side where they would be handy. The special forces camp was located in a valley which was 7 miles wide, and the low hills surrounding it were 1,000 feet MSL at the highest point.

By the time they completed their flight logs and had thoroughly discussed their plans, it was 2230 hours, so they departed for their tents.

Dawn came as a subtle change from black to dark gray. The sky lightened only gradually and slowly disclosed a moisture laden solid overcast which hid most of the surrounding hills. No rain was falling, but a light mist hung in the air, covering the land with dampness.

Ghost and Carter met in the operations tent, more by accident than plan. Both looked as if they hadn't slept much during the night. Captain Burns greeted them with a cheerfulness which seemed out of place, considering the hour.

"Why don't you two grab a cup of coffee and I'll give you your final briefing," he said.

As the two pilots filled their cups and seated themselves, he searched the papers on his desk and finally found the one he was looking for.

"The detachment commander radioed in a message late last night," Captain Burns stated. "His troops finished clearing a landing area and determined that a magnetic azimuth of 070° would be the best landing direction. His best estimate of the elevation was 1,600 feet. He will have one of his NCOs monitoring the SOI aviation FM frequency and requested that you use Blue Devil as your call sign. He will be Red Devil. He advised that there is a sniper somewhere to the northwest of the area, but doesn't expect any other enemy activity.

"I have also gotten a forecast for here and your destination. You can expect a 300-foot ceiling with a mile of visibility in the valleys. This should hold until 1300, at which time the ceiling should gradually lift. You can expect intermittent light rain and mist. The wind will generally be from 350° at 10 knots. Sergeant Packard has already loaded and pulled the daily on your aircraft. He said he would meet you at the mess tent. If you will give me your route and takeoff time, I will file with FOC for you. Any questions?"

"No sir," said Ghost. He supplied Captain Burns with the necessary deails, then he and Carter departed for the mess tent.

When the two pilots had finished eating and the table was

Ghost confidently sized up the situation

cleared, they began their final planning on the tactical map.

First, they penciled in a 4,000 by 2,000 meter rectangle, centered on XUC beacon and oriented with the long axis on a landing course of 070°. They then selected the highest obstacle within the rectangle, which turned out to be a 1,650-foot knoll. Then they proceeded with detailed plans for the tactical ADF approach, landing axis, altitude, etc.

"It looks fairly simple," said Ghost, pausing to relight his pipe. "I will fly the approach and let you keep me straight on the headings, times, and altitudes. That wraps up the planning. Since it's already 0710 hours, I guess the three of us had better go out to the aircraft and get started."

PFC Jczelowski, the other gunner, met them at the aircraft. His nickname, naturally, was "Ski" and he was a good man to have aboard.

The UH-1D looked anything but sleek. Although only 15 months away from the factory, the ship appeared to have served in World War I and not been repainted since. Mechanically, she was sound, but the rivulets of moisture running down her wrinkled and worn skin gave one the impression of looking at a sweat streaked laborer humbled by fatigue.

"She looks OK, John," said Ghost as he finished inspecting the strapped down load of ammunition. "If this stuff blows, we are going to be 'parts a-go-go.' "

While the two pilots strapped in, PFC Jczelowski and Sergeant Packard readied their machineguns for action. Soon, the engine came to life and the drooping blade began movement as a great accelerating scythe.

Carter sat in the left seat and took over the runup duties while Ghost checked the flight instruments and navigational aids. They had already discussed who was to accomplish which duties during the flight, and there was no wasted motion. Ghost would do the flying and navigation. Carter was to copy all clearances, tune the radios, compute estimates, crosscheck the navigation, and assist in flying the aircraft. The reports would be handled by Ghost.

"Sergeant, are you and Ski all set to go?" inquired Ghost.

"Yes sir," they responded in unison.

"Soon Lon Tower, this is 9163, west parking, IFR Red Devil. Over."

"Roger 9163. Cleared to hover for a north departure. The wind is 350 at 6 knots, altimeter 2944, time 0825. Call when on the pad. Over."

"9163 roger."

Ghost hovered the heavily loaded Huey to the takeoff pad, putting the aircraft through the various movements necessary to ensure that all flight instruments were working. When he reached the pad, he set the aircraft down so that it would be in a crab on takeoff to maintain a track parallel to runway 01.

"Soon Lon tower, 9163 ready for my clearance."

"Roger 9163. FOC clears you via flight planned route. Maintain 1,500. Maintain runway heading until reaching 1,000, climb on course, contact FOC on Fox Mike immediately after takeoff. Read back. Over."

"9163 roger," said Ghost, and he read back the clearance.

"Roger 9163. Cleared for takeoff."

Ghost applied power and the aircraft smoothly broke ground, only to disappear into the ugly gray clouds seconds later.

"FOC, Army 9163 off Soon Lon 30, heading 005. Over."

"Roger 9163" was the only reply.

At 1,000 feet Ghost turned to intercept the 035 course to Soon Lon NDB. Upon reaching 1,500 feet, he accomplished the level off check.

"John, what will our estimate to XUC be?" asked Ghost.

"0900, with the wind," replied Carter.

As they crossed over the now hidden Soon Lon NDB, Ghost turned to establish the 330° course to XUC, noted the time, and gave his position report.

There's somebody shooting at us

"Roger 9163. Climb and maintain your MEA. Over."

"9163 out of 1,500 at 35. Over," answered Ghost. He applied power and the aircraft, now agile at 70 knots, climbed upward to 3,250 feet.

The crew made small talk until the somber voice of FOC came over the radio once again.

"9163, contact Red Devil now. If no contact, return this frequency immediately. Contact FOC when airborne from destination or if executing missed approach at destination. Over."

"9163 roger."

Carter switched over to the Red Devil frequency and also tuned the ADF to XUC.

"Red Devil, this is Blue Devil estimating your position 0900. Over."

"Roger Blue Devil, this is Red Devil. We are ready to accept you. The landing field will be just beyond the green smoke. Request no further transmissions unless necessary. Out."

"Boy, that guy isn't very talkative, is he," remarked Carter.

At 0902 hours the ADF needle indicated station passage. John, already prepared, called off the heading of 295° and started the time. Ghost responded with the controls and simultaneously began a 500 fpm descent, cursing his momentary insufficient right pedal.

"Now turn left and home to the station," called off Carter at the end of 15 seconds.

At 2,550 feet Ghost stopped his descent. Seconds later, station passage registered and Carter gave a heading of 025°. When 15 seconds were up, Ghost turned right and began homing again.

The last loop was the same as the first except the descent was to 1,850 feet.

"I've got visual contact," remarked Carter joyously.

"OK, John, you have it," said Ghost. He remained loosely on the controls and continued monitoring the instruments.

"There's the green smoke, just like they said, and I see the landing area. Here we go," replied Carter.

Wheee POP!

"— —, there's somebody down there shooting at us!" exclaimed Carter.

The door gunner was tensed, ready to shoot anything suspicious

Already committed for landing, Carter expedited the approach and they came to a bounce-bump setdown. Sergeant Packard and Ski were tensed at the guns ready to shoot anything suspicious but afraid to let loose for fear of shooting special forces personnel.

After a short eternity, a party of obviously American GIs approached the aircraft from the brush. The shortest "Green Beret" stepped up to Ghost's window.

"Relax, Chief. The area is secure. Why don't you shut down and join us for some coffee while we load the litter case? By the way, I am Captain Joyner," he shouted above the aircraft noise.

"There's one guy out there that didn't get the word, Captain," shouted back Ghost while motioning for Carter to cut the engine.

As Ghost climbed out, Captain Joyner continued, "You must mean old 'one-shot-Charlie.' He's been pretty harmless since one of your gunships gave him hell a while back. I think he misses on purpose, now."

Departing from the landing field was accomplished with ease. With the ammunition load gone and only a litter patient in the cargo compartment, 9163 climbed with power to spare. An ascent to 2,550 was made on a heading of 070° and then the aircraft tracked into the station, leveling off at MEA. FOC had already been called and clearance to Soon Lon NDB had been given.

Five minutes out from Soon Lon NDB, FOC turned 9163 over to Soon Lon tactical GCA.

"Soon Lon GCA, Army 9163 inbound to Soon Lon NDB. Heading 150, 3,250, requesting precision approach."

"Roger, 9163. Depart Soon Lon

Clouds Over Soon Lon Valley

NDB heading 190, descend to 2,000. Report departing."

As Ghost finished rogering the GCA, he was startled to see the 20-minute fuel caution light blink on.

"John, we have problems. I think 'one-shot-Charlie' scored. Check to see if it could be a circuit breaker or something."

"I can't find anything wrong, Ghost. Unfortunately, I think that that light is right because the fuel gauge agrees. We had better get on the horn to Soon Lon GCA."

Ghost called the GCA, trying to hide the sense of urgency in his voice. The GCA controller, sensing the situation, took steps to expedite the approach, but somehow maintained a calm and reassuring tone of voice.

" You are on final—4 miles from touchdown—no need to acknowledge further communications unless requested to do so—"

"Three miles—"

"Two miles—"

"One mile—"

"Passing through GCA minimums—"

"Over touchdown—"

"I have it," Carter called over the intercom. He rapidly decelerated the Huey and set it down just clear of the runway.

The alert crew surrounded the aircraft, fire extinguishers in hand, as the switches were cut. Happily, nothing happened and the would-be firefighters drifted slowly away.

After being debriefed, the two pilots adjourned to the mess tent to enjoy one of Sergeant Pendergast's rich lunches and relax by discussing the flight.

"Well, I think we both learned something on that flight, didn't we, John?" asked Ghost as he patiently relit his pipe for the tenth time that day.

"You're right, Ghost," answered Carter. "Never, never, never assume anything, especially when flying IFR."

As they continued to talk, the sky over Soon Lon Valley gradually lightened, and soon all evidence of their accomplishment would become invisible water vapor.

Magnetic Chip Detectors

Colonel Edward J. Chrysler

THE MAGNETIC chip detector is a warning device designed to inform the pilot that metal contaminants are present in the oil system. As a warning device it does its job quite well and has prevented unnecessary damage to many aircraft. But there have been a few occasions in which the chip detector itself caused engine failures.

A large number of activities have reported finding badly corroded chip detectors on U-1A and U-6A aircraft. In two instances the corrosion had progressed sufficiently to allow the center electrode to fall free from the plug, resulting in loss of oil.

It was decided to test the plug at the contractor's site to determine the exact cause of failure. The plug was installed in the sump of an oil tank; a 28 volt positive potential was applied to the center electrode, the same as during flight operation. By introducing sulphuric acid into the oil as a contaminant, a condition was created that would cause corrosion on the plug very similar to the corrosion on the plugs received from the field.

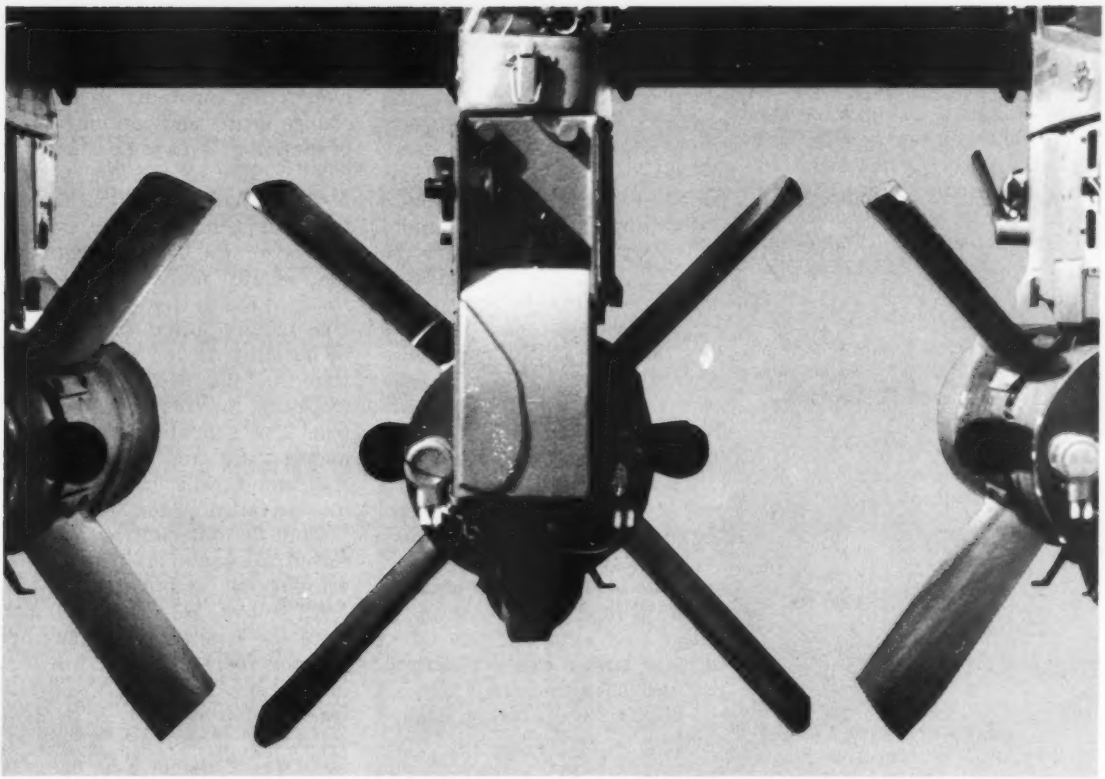
Tests showed that the corrosion was a result of the current flowing through the ionized electrolyte, which was formed when the products of combustion and other contaminants mixed with the engine oil. The center electrode of the chip detector plug acts as an anode since it is at a positive potential of 28 volts. The chip detector body and the entire engine act as a cathode since they are connected to the negative side of the aircraft battery. All conditions for electrolytic corrosion are therefore present, namely anode, cathode and electrolyte. This results in sacrificing the center electrode and eventual plating of the displaced metal upon the chip detector body and oil wetted parts of the engine.

To alleviate this problem one of two things had to be accomplished, either eliminate the 28 volt potential at the center electrode or make the center electrode of material that would resist corrosion. The latter solution proved to be easier and less costly. A new plug was designed which incorporated a titanium center electrode. The new plug was tested and after several days it showed no signs of corrosion.

Plugs with titanium electrodes are now being used on U-6A type aircraft, and will soon be in use on the U-1A aircraft.

The old plug can still be used without sacrificing reliability, but frequent inspection will be necessary.

COL Chrysler is Director of Research, Development and Engineering, U. S. Army Aviation Materiel Command, St. Louis, Mo.



M-22s in Combat

This wire-guided missile system has proved effective in combat

Captain James R. Foreman

WIRES AND helicopters don't mix."

That was my opinion before going to the M-22 course at Fort Rucker, Alabama. After attending the course, I changed my mind. I realized that in this case, the helicopter is right at home with the M-22. For the uninitiated, the M-22 is the former SS-11 wire guided missile.

After completing the course at Fort Rucker I was sent to Vietnam and assigned to the division complex at An Khe. The aerial artillery battalion then initiated operations in support of the division. When we were not involved in these increasingly large operations, our sections and platoons were conducting practice missions and becoming familiar with the terrain.

Even though M-22 requirements were only a small part of the battery's overall missions—in fact, no missions were received during this early period—our operations had established standby crews and a standby helicopter equipped with this system. The division had not begun search and clear operations, but was concentrating on establishing and securing the division perimeter.

CPT Foreman is Chief, M-22 Section, Dept of Tactics, Ft Rucker, Ala.

M-22s in Combat

This period of lull before the storm enabled us to check out the aircraft and equipment and train new personnel. We had to install the M-22 system ourselves. It had never been unwrapped, and putting it together presented no major problem until we came up with a few extra parts. Fortunately, it checked out perfectly. We passed the word that we were maintaining a standby helicopter equipped with the M-22 system.

The next month a reconnaissance helicopter located a series of four bunkers and relayed the spot report to the artillery battalion at Duc Co Special Forces Camp. The mission was relayed to a platoon of the Aerial Artillery Battalion who were on standby alert at the same camp. The platoon along with our M-22 helicopter proceeded to the location which had been marked by the recon helicopter with smoke. After positively identifying the bunkers, the M-22 helicopter made four firing runs followed by suppressive fire from the rocket ships. Surveillance by the reconnaissance helicopter confirmed three bunkers destroyed and one damaged.

A unique situation occurred later in which the M-22 subsystem was employed effectively as a precision weapon. I was on standby with the M-22 helicopter and an aerial artillery platoon at the Duc Co Special Forces Camp. About 5 miles to the east was a village where we suspected a Viet Cong school was operating. All available intelligence indicated that the majority of the villagers were not sympathetic to the Viet Cong but that they could do nothing to rid themselves of their captors.

An aerial recon showed that the village had well constructed fortifications on all four sides and that entry to the village was through a main gate on the south and a smaller gate on the west. Any attempt to assault the village could mean heavy casualties and also endanger the lives and property of the villagers. Any of the standard weapons such as artillery, air launched 2.75" rockets, or bombs had a dispersion radius that could well do as much damage to the village as to the fortifications that surrounded it. Also, the gates were probably booby-trapped. The village, along with two others, lay across the main infiltration route from the north. They probably provided a sanctuary to the Viet Cong, so pacification of these villages would not only serve to liberate the villages but also deny the Cong their use.

One morning at the first ray of light, the M-22 helicopter streaked down the road to the south of the village and launched one of its six wire guided missiles, destroying the bunker directly behind the main gate. At the same time three aerial rocket ships provided suppressive fire on the outer perimeter of the village. The M-22 ship made a complete turn and launched a second missile which destroyed the main gate. Upon impact of the second missile the special forces stormed the gate and with little resistance gained entry to the village.

After destroying the main gate the M-22 ship circled and launched a missile at the west gate. The missile destroyed the gate and provided an access for a second special forces team waiting in a treeline outside the village. Both of these teams had departed Duc Co three days before, seemingly on patrols. Only a few key individuals knew the real purpose and destination of their mission.

The village was seized, along with some Viet Cong and weapons. This strategic village would no longer provide the Viet Cong with a sanctuary from which they could operate and train.

One real advantage the helicopter has given U. S. Forces in Vietnam is the capability to quickly change tactics and concentrations of firepower. This same characteristic applies to the use of the M-22. We had realized that targets for this system are not as numerous as for the XM-3 system but that we still needed to have the M-22 available on short notice. One battery solved the problem by installing all the internal hardware for the M-22 system and mounting the complete XM-3 system. This procedure enabled the maintenance crew to quickly install the missile launchers if a mission called for the M-22 system.

One of our warrant officers solved the same problem by developing a combination XM-3/M-22 system. He concluded that since the systems were internally separate in the helicopter it was only a question of combining the external hardware to have dual capability. The result of his efforts was a system that fired 24 rockets and two M-22 missiles. All fabrication of the mounts and electrical wiring was designed and built by the officer. His ingenious system certainly added to the flexibility of the unit and decreased the response time for all future M-22 missions.

The combination system got its first test during the second week in December. A helicopter pilot spotted a series of caves about 40 miles away in a no-man's land that was mountainous and unoccupied by civilians. This rugged country was a perfect location for the Viet Cong and had never been contested by friendly troops. Two caves that interested us were partially concealed in front by waterfalls, but they were not very difficult to see from the air. The first cave was believed to be either a command post or a radio station, and a cable used as an antenna

had been spotted.

Our fire team consisted of two helicopters, a gun ship mounting a combination XM-16 system and one with our combination M-22/XM-3 system. The gun ship went in first and fired some rockets around the cave to discourage anyone who might have seen our approach. As soon as the pilot broke to the right, the warrant officer fired several pairs of rockets and signaled to me that I was clear to fire an M-22 at the cave. I fired almost immediately and guided the missile for what seemed the longest seconds in my life, but it entered the cave and exploded, sending a big cloud of smoke out the front.

The second cave was almost identical to the first except it was masked in front by a hill that lay some 1500 meters away. The missile had to be fired from a much higher altitude to clear the top of the hill. The other gun ship made the first run, firing the remainder of its rockets and covering the area with machinegun fire. At the same time they identified the target and described it to make sure we knew where it was. The target could be seen in back of the waterfall. Personnel had been spotted around this cave and it was probably serving as quarters to the Viet Cong.

As soon as the gun ship broke to the right I fired the second and last M-22. When firing from 2,000 feet altitude, as we were with this missile, I noticed that gravity and the tremendous speed the missile acquires makes control even more critical than is normal. Clearing the hill in front of the cave suddenly became a more formidable obstacle than I had anticipated.

Finally the M-22 responded to my command to climb. A split second later it entered the cave, exploding first with a concussion and debris and then with smoke and fire. The combination system had worked well on its first trial, but even more important the M-22 had destroyed both targets.

A configuration M-22/XM-3 system on a UH-1B

Army aviation has taken tremendous strides as a result of continuous efforts to support the infantry soldier in Vietnam. Sophisticated devices such as the Starlight scope, infrared photography, and radar are being employed for target acquisition. Close behind them are weapons that use this information to destroy the enemy.

The M-22 has proved itself as a close support weapon with a high degree of sophistication. It has enabled the commander to discriminate in the destruction of targets to a degree that no other air-launched weapon can approach. It has proved to be a highly accurate and fully reliable system that requires very little support. This system's role has been not to replace any other weapons system but to supplement them with a truly effective and precise weapons system.

ANNUAL INDEX AVAILABLE

The annual index for Volume 12, 1966, ARMY AVIATION DIGEST is available by request to the: Editor-in-Chief, U. S. ARMY AVIATION DIGEST, Fort Rucker, Alabama 36360.

We were in a vicious thunderstorm. Our airspeed hit 200 knots and our altimeter 1,500 feet as we reached bottom and began our ride to the top.

The Weather's Fine!

Major Donald R. Drumm

IT WAS 0500, Sunday, 23 April 1961. Captain Smith and I were waiting at the hotel for the general's driver to take us to the airport. We had arrived in Des Moines the night before with the general and his aide. The general was to give a speech to the Reserve Officers Association. It was a typically fine evening with cocktails, dinner, and the general's talk. Captain Smith and I retired early as takeoff was scheduled for 0700 the next morning.

The driver arrived on time, and as we drove to the airport we noticed the streets were wet. "It must have rained," I said.

"Yes," replied Captain Smith, "I heard some thunder last night; there might be some thunderstorms in the area."

"I hope not," I said. "I'd like to be home by 0930 and salvage what is left of this weekend."

The airport was quiet this early in the morning and the restaurant didn't open until 0600. We decided to check the weather first then eat breakfast. The weather bureau was quiet also, except for the chatter of the teletype machines. We were just in time to catch the 0500 weather sequence.

"How's the weather between here and Minneapolis?" I asked.

"Not too good," the weatherman replied. "This cold front has produced some thunderstorms in our area and low ceilings around Minneapolis. Would you care to check the radar scope?"

The radar scope plainly showed

MAJ Drumm is now serving in Vietnam.

Our cabin door popped open

some echoes along our route. "When do you expect an improvement?" Smith asked.

"The thunderstorms are moving northeastward," the weatherman said, "and should be well east of your route by 0900. Minneapolis will still be IFR though."

"Oh well," I said, "noon's not a bad time to get home." Captain Smith called the general's aide and informed him of the weather situation and the new takeoff time, 0900. We bought a Sunday paper and had a leisurely breakfast. As we left the restaurant we noticed the tempo of the airport had begun to pick up. "It looks like a busy day for the airlines," I said.

Our U-8E was just where we had parked it the night before. "You preflight the aircraft," Captain Smith said, "and I'll file our flight plan."

As I approached the aircraft I noticed it had double tiedowns. "They must have been expecting some high winds last night," I thought. I glanced at the sky and noticed it was beginning to clear, with some blue sky showing, through, and an occasional glimpse of the sun.

Our U-8E was VHF equipped. We didn't use headsets, instead we had a speaker in the ceiling and used a hand held mike. With the preflight completed, I returned to the civilian operator's office to sign for the fuel and check on Captain Smith. He had just hung up the telephone as I walked in. "The flight plan is filed and I checked the weather again," he said. "It looks like we will make our 0900 departure."

"How about the thunderstorms?" I asked.

"They are still there," he replied, "but weather said they will be east of our course at departure time and should present no hazard. Minneapolis is forecast to be IFR at our ETA so I filed an instrument flight plan: V-13, 3,000 feet with 1 hour 30 minutes en route." It was now 0800.

I met the general and his aide when they arrived and told them we were ready to go. As Captain Smith got our passengers situated and ran up the U-8E, I made a last minute check of the weather. I had read articles about thunderstorm flying and certainly did not want to encounter any of them, especially IFR. The weatherman informed me that all the thunderstorms had moved east of our path, but we would pick up lowering ceilings and rain around Mason City, Iowa. The Des Moines present weather was 4,000 foot broken and 10 miles visibility.

Breathing a sigh of relief, I ran to the aircraft. "The weather's fine; it should be a good flight," I said.

We taxied to the runup area and received our clearance. "ATC clears Army 34043 to the Minneapolis Airport, V-13, maintain 3,000, contact Kansas City Center frequency 127.2 crossing Newton intersection," the tower operator said. Captain Smith taxied onto the runway and jammed the throttles forward. As we broke ground I reached over and hit the landing gear lever. I heard the gear seat themselves in the wells with the usual thump. "0900," I noticed, "right on time."

Captain Smith established a steady 500 foot per minute climb. As we reached our assigned altitude and leveled off, a civilian pilot flying a small twin engine aircraft reported that he had encountered a severe jolt en route from Newton VOR to Des Moines which had popped open his door.

Smith looked at me and smiled. "He probably didn't have it closed tight," I said. I glanced at the general and his aide; they were reading the Sunday paper. We were VFR at this time and the occasional sun felt good shining through the cockpit windows.

As we approached Newton intersection I noticed an unusually black, ominous looking cloud ahead. The base was about 1,500 feet and the top disappeared into the overcast at about 6,000 feet. "Maybe we ought to detour around this cloud," I said.

"There isn't any rain coming out of it," Smith replied, "and the area is clear all around. We will maintain our heading and poke our nose into it; if things get too bad we can turn west and be out of it in a few seconds."

"All right," I said. I tightened my seat belt and checked our passengers; they were reading the Sunday paper. It was now 0915.

Captain Smith adjusted the power and we entered the cloud at 150 knots. All of a sudden it became very dark, as if someone had turned out the lights. I turned on the instrument lights. Then we received a severe jolt and our cabin door popped open. Immediately there was a loud rushing noise and the cabin was filled with the Sunday paper, sectionals and navigation charts — all being sucked out the open door.

Airspeed dropped from 150 knots to 90 knots despite full power. Our altitude was 5,000 feet and rising. Then as quickly as we started up, our altimeter started a sickening counterclockwise rotation. With power off and passing through 2,000 feet, Kansas City Center called asking for our position. I couldn't catch the microphone as it floated around the cockpit.

Our airspeed reached 200 knots, altimeter 1,500 feet as we reached

We taxied to the hangar and checked for structural damage

bottom and began our ride to the top. Captain Smith had both hands on the wheel and tried a gentle turn to the west. Each attempt to turn seemed to aggravate the situation and stand the aircraft on its side. After what seemed like an eternity, the cloud spit us out in a spiral and Captain Smith managed to recover the aircraft at 500 feet.

We still had the wings and were flying. I glanced out and the cloud now had a base of about 500 feet. We were completely disoriented and all the maps were gone. The cockpit was full of the Sunday paper. Dick Tracy may be a good detective but unfortunately he couldn't tell us where we were.

I remembered there was a small airport at Newton, a few miles east of our original course and near the Newton Omni. As I centered the needle, Captain Smith took up a heading of 090. "If only this aircraft holds together a few more minutes we'll make it," I thought.

Newton airport appeared in the distance. I lowered the landing gear and the lights indicated all three were down and locked. Captain Smith reduced power and set up for a straight-in approach. We touched down on the rain-soaked runway, taxied to the hangar and shut down. "You call Des Moines and report our situation," Captain Smith said, "and I will check for any structural damage."

I called Des Moines and told them we were down at Newton and to cancel our flight plan. "Roger," he said, "we had you on radar when you disappeared into that cloud. Incidentally, just 10 miles north of Newton that same cloud touched down as a tornado."

It was now 1000 hours. I then thought of my last statement to my copilot. "The weather's fine, it should be a good flight."

Aviator Lands Wingless Bird Dog

ARMY SPOTTER pilot CPT Paul Florio was 300 feet above rugged jungle when his right wing exploded.

Florio, of the 17th Combat Aviation Group's 219th Recon Company, 223rd Battalion, was on an aerial scouting mission 35 miles southwest of Pleiku when a VC bullet struck and detonated one of the phosphorous target-making rockets his O-1 Bird Dog carried beneath its wings. The blast ruptured the right wing's forward edge, wiping out the right landing gear and slightly wounding Florio's observer, LT Ronald J. Pollum of the 4th Infantry Div.

Still 15 miles from the nearest airfield, Duc Co, Florio fought desperately to keep his bird in the air. Mutilation of the right wing had caused it to lose lift and drag heavily, yawing the small plane to the right. He dropped his wing flaps to the full-down position, steered hard to the left, and rammed full throttle into his faltering craft.

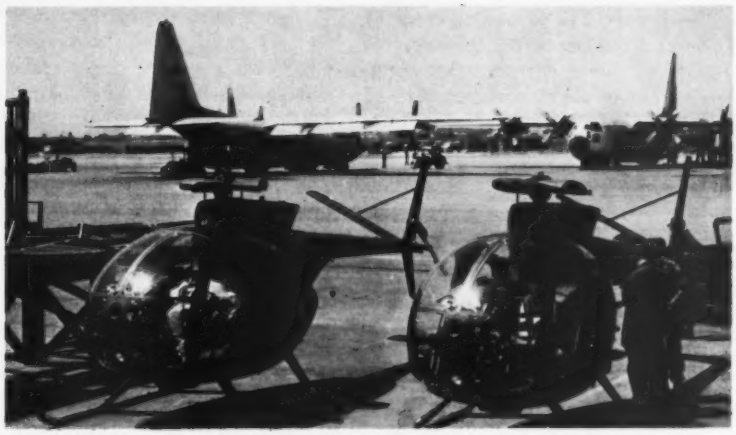
This move slowed — but failed to stop — his descent. It was all he could do. Now, like it or not, he was coming down. But where — the Duc Co airstrip, or the VC-infested jungle?

Fifteen minutes later the crippled airplane had nearly worked itself out of the sky, but Florio had the field in sight. Whipping across the treetops on final approach, he wrestled his plane down for the risky one-wheel landing forced by loss of his right tire.

When his rolling Bird Dog slowed, and Florio could no longer hold the worthless right wheel off the runway, he braked his left one hard and bumped to a skidding stop.

—THE ARMY REPORTER

Cayuse in Vietnam



The first OH-6A in Vietnam arrived at Tan Son Nhut Air Base

AFTER MONTHS of anticipation, the OH-6A Cayuse has arrived in Vietnam. The Cayuse is a light observation helicopter manufactured by the Hughes Tool Company of Culver City, Calif. The result of numerous technical advancements in the science of aviation, the Cayuse is considered to be one of the most advanced rotary wing aircraft in production today.

Two OH-6A helicopters arrived at Tan Son Nhut on February 15 and were assigned to the Army Aircraft Mobile Technical Assistance Program school of the 34th General Support Group (AM&S). They are presently with the New Equipment Training Team (NET) at two separate locations. One is at a permanent site with the AAMTAP school in Vung Tau, the other with the mobile segment of the team presently at An Khe.

The NET Team is composed of officers, NCOs and civilian specialists. It will provide an in-country training base for familiarization of aircraft mechanics in the anticipation of the arrival of the Cayuse to the line aviation units.

Providing the direct support, general support, and depot level component repair for the new aircraft is the 34th General Support Group (AM&S). The group presently has the responsibility for maintenance and supply of all Army aviation in Vietnam in the areas of airframe and powerplant, avionics and armament.

The Cayuse was designed to fit into the maintenance system with a minimum of effort. Necessary organizational maintenance can be performed on this aircraft without the use of any special tools. The only necessary tools are readily available in the standard Army tool kit. The armament subsystem of the OH-6A is the XM-27 which offers simplicity of operation, ease of maintenance, and an adjustable rate of fire from 2,000 to 4,000 shots per minute. The GAU-2B/A "Minigun" is common to both the XM-21 and XM-27 aircraft armament subsystems, allowing interchange of weapons.

Of the avionics systems and ancillery equipment installed in the OH-6A, all, with only one exception, are used in other aircraft currently employed in Vietnam. The one exception is a new piece of equipment, the AN/ASN-43 Direction Finder Set. This set is to be evacuated to the Sacramento Depot for maintenance under the Electronic Items Depot Contractor Support program.

Engine specifications are impressive, especially in the power to weight ratio. The Allison T63-A-5A (250 series) weighs only 136 pounds, yet has an output shaft horsepower of 317 horsepower, with a cruising continuous maximum horsepower of 270 hp. Either JP-4 or JP-5 can be used by the engine.

The transmission is a great advance over previous gear boxes. Incorporating only two gear meshes instead of 22, the factor of friction is held to a minimum, thus allowing maximum power to turn the four rotor blades.

Numerous records have been set by the Cayuse. It has the capability to hover out of ground effect at 6,000 feet and can carry enough C-rations to feed an entire company in the field for a whole day, or it can carry as many as five passengers along with the pilot.

Few aircraft have been introduced with more credentials. Few have had the extensive benefit of the advancements in the science of aviation as the Cayuse. But when it is introduced in Vietnam for full-time duty, the 34th General Support Group (AM&S) will be ready to keep it in the air.

Mohawks were respectfully called "Silent Death" by the Viet Cong

The Fine Art of Aerial Observation

Captain Mark L. Bellamy

LIKE ALL ARMIES, the Viet Cong army contains a certain number of duds. These duds make detection easy for us by leaving fresh dirt exposed around their foxholes and trench works and failing to completely sink or cover their sampans. When something like this happens, it is a fortunate break for us. However, the guerilla's best air defense is a passive one, and they use camouflage on a level attained by few sophisticated armies.

They have arrived at this high degree of proficiency through 20-plus years of practical application. Though they are good, their deceitfulness still leaves signs, especially when a state of urgency or haste exists.

Disturbances in the natural vegetation are signs that someone is hiding from you. Various articles bring this out well by indicating that on narrow canals, the VC will conceal their sampans as you fly over by pulling the tall grass on canal banks over their small vessels. This bends the grass over, sometimes causing it to bend into the wind instead of with the wind. One article describes how a training camp was concealed when the surrounding trees weren't thick enough to completely cover the buildings. Trees were bent over and tied down to conceal the buildings. This com-

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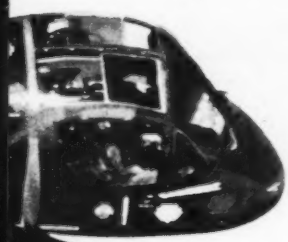
CPT Bellamy is now serving in Vietnam.

plex was discovered when a pilot realized he was looking at the bottoms of the leaves instead of the tops.

Finding camps, vessels, and vehicles is difficult, but locating the individual soldier is even harder. In some Viet Cong units each soldier camouflages both his uniform and his helmet. As they march along, each soldier maintains the camouflage of the person in front of him. Movement is about the only thing that will give these units away. And that, of course,



is what you must be alert for. Once you see the first one move, with a little scrutinization you can usually detect many of the others.

A source that I consider reliable once told me that I flew over a VC company without seeing any of them. This communist unit was crossing a large open rice field laced with small dikes but completely without tall rice or trees. A government sympathizer was watching them and heard my O-1 approach. He was sure they would be detected but the Cong had a trick left. They too heard my healthy Continental purr, and as I approached they lay down single file, head to foot, in a straight line in the shallow water. As I flew over, I failed to notice any difference between the line they formed and any other small dike in that large rice field.

THE ELEMENT OF SURPRISE

That brings up another point. If you want to see what a certain young lady usually looks like go see her when she isn't expecting you. It works the same way with Charlie. Surprise him and you're going to learn a lot more.

As I see it three aircraft are doing this looking job for the Army: the Bird Dog, Mohawk, and armed Huey. Surprise is at best difficult in the Huey. Even at low level the noise from the rotor is usually heard before the aircraft arrives. Many units spotted by armed ships allowed themselves to be spotted by yielding to the temptation to engage the helicopters.

Noise characteristics of the Bird Dog are such that at low level, noise and aircraft pass over a suspected target simultaneously. And of course, the Mohawk travels ahead of its noise at low level. In fact, Mohawks of the old 23rd SWAD were respectfully called "Silent Death" by the Viet Cong.

After you "surprise" an area you have to interpret what you find. Such things as clothes lines with only adult male items in a village should indicate something. Also, sightings of villages with all male citizens or no males leave points to ponder.

People in friendly areas of the world generally like to look at aircraft. If everyone refuses to look up or if they run it may indicate hostility toward you, fear, or a guilty conscience.

SURVIVAL IN THE TARGET AREA

Viet Cong antiaircraft units have a levy to fill during each calendar year. It would be disappointing and downright dangerous to discover a hostile unit only to become a statistic of theirs. So it's necessary to be able to survive in the target area.

Train yourself to see as much as possible on your first pass through the area. Your second and subsequent passes will surprise no one. Make your pass at as high a speed as possible, using military rated power settings for your aircraft. In mountainous areas make your approach downhill to gain extra speed.

Attempt to conceal your approach. The VC have people assigned to the duty of aircraft listener/spotter. Use the sun for additional protection. Make your pass so that the aircraft's shadow is on the suspected target. This means anyone shooting at you from that area will have the sun in his eyes.

Wind and terrain can also help you. Favorable terrain can be used to conceal your approach. When possible, always fly low over trees on your target confirmation pass. If you have ever hunted ducks in a wooded area the reason is apparent. Flying parallel to a treeline gives anyone in that treeline an unlimited field of fire. Flying downwind of the target will help dissipate aircraft noises before they reach the target, thus increasing the chance of your being undetected.

If you are unarmed but plan to engage the target (airstrike or artillery) you must keep your target under constant surveillance. The guerillas on the ground know what's happening next. Turn your back and all you have left to shoot at is a deserted camp or an empty field. So stay in the area but climb high enough to be relatively safe from small arms fire.

They will still attempt to sneak away in all directions but there will not be the mass exodus that would occur should you leave. Keep track of as many as possible while waiting for that first artillery round or the strike aircraft.

Aerial observation is a dangerous game. However, the aviator who develops cunningness can survive in this environment and contribute greatly to a counterinsurgency movement.

are you STANDARDIZED or MECHANIZED?

Major Herbert H. Guderian

FROM THE DAY you got into the aviation program, you've heard the terms "mechanical flying" and "standardization." It was constantly pitched at you, "Don't be mechanical and by all means get standardized." So, let's examine these terms and see how they apply to pilots.

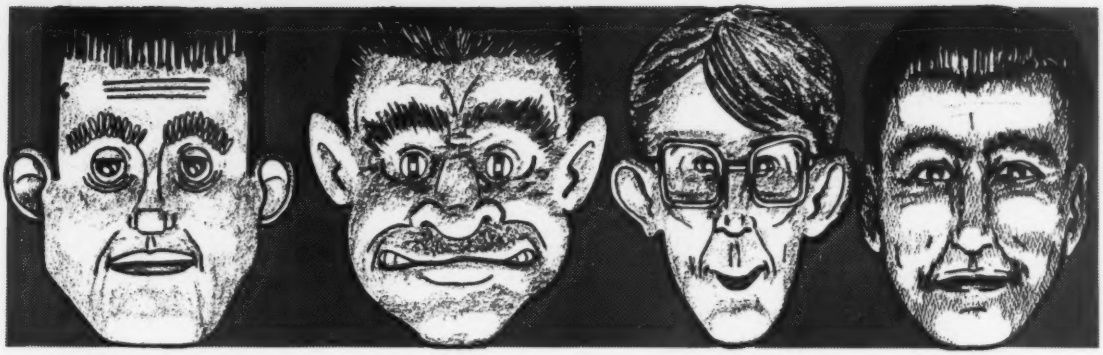
You've seen the precise individual who is unvarying in his method of executing any specific maneuver. Like, by the numbers, man! So you point your finger of derision at him and say, "He is a mechanical pilot." But have you ever seen him have an accident that was caused by some mistake he made? By the same token, how prepared is he to cope with an emergency situation for which he hasn't rehearsed all the numbers?

Our next specimen under the microscope is the "Tiger." You know, the guy who flies an airplane as if it were made of case hardened steel. A real throttle-bender. He's the one who lands shorter, takes off quicker and flies lower over the treetops than anyone else. You point the same derisive digit at him and say, "He is a nut. He is looking for a place to become a catastrophe." Of him you say, "He's not standardized."

Our third subject bears the name and demeanor faintly resembling Caspar Milquetoast. He's the timid soul, the go-around champ of the base. He flies his bird as if it were an assemblage of balsa wood and tissue paper, precariously held together with glue. No chance taker, never an accident in his long career but his fair share of precautionary landings. "No guts, you sneer. You gotta be aggressive." You can't really tell if he's mechanical or over-standardized.

Last we have the average pilot, the one who is part of the large

MAJ Guderian is the Aviation Safety Officer, Fort Hood, Texas.



Mechanical man | Tiger | Caspar Milquetoast | Journeyman

majority of the Army's aviators. He's the journeyman. Well schooled, level headed, the man who goes out periodically and practices basic flying. He passes his first instrument check because he stays current. His commander feels confident when he sends him out on a mission. We point at him and say proudly, "That's my idea of a pilot." We never hang that nasty handle "mechanical pilot" on him. Of course, he is standardized.

A rough interpretation of Webster's definition of mechanical: machine-like, automatic, as if from force of habit, lacking spontaneity, expression or intelligence.

Now, here's an eye opener. A general definition of standardization: to make standard or uniform, cause to be without variations or irregularities. Doesn't sound like there's too much difference. Our precise friend fits that "cause to be without variation" to a tee. So he must be standardized. But "machinelike" fits him too. So, what is he?

Our "tiger" certainly doesn't meet the requirements of "mechanical." And I dare say he isn't exactly standard either.

Old Caspar seems to incorporate some traits from each category.

Let's face one basic fact about flying. After you've met the exacting requirements demanded by your flight instructor, and you've been turned loose with your new silver wings, your personality comes to the fore. The day after you graduate, you begin to develop a thing called technique. There is no one way to fly an airplane. Forget what Webster says. It's your way to fly your bird. By the book definition, you are neither mechanized nor standardized.

I offer you my definition of mechanical flying and standardization. I base these definitions on a background of seven years of IPing in the U-6, five years as an instructor examiner, four years as a U-8 IP, and the teachings of instructor pilots I have known.

Mechanical flying is flying by rote. It's flying by the numbers because it was taught that way. What was good three years ago in flight school is good today. You know exactly as much about your aircraft and your own capabilities as you did then.

Standardization, to me, is flying within the limitations of your aircraft and your own self-analyzed capabilities. It's the practice of respecting forces on the bird. It's keeping the engine power within the limits prescribed by the engineers who designed it. It's experimenting after calculating.

We groan with apprehension when we face a stan-ride and say, "That nasty old IP is going to tell me I don't know how to fly this machine." We try to second-guess the IP and fly the way we think he would. In reality, that IP wants to see your technique, how you do it. Is it safe? Is it within the limits for long aircraft, engine and pilot life?

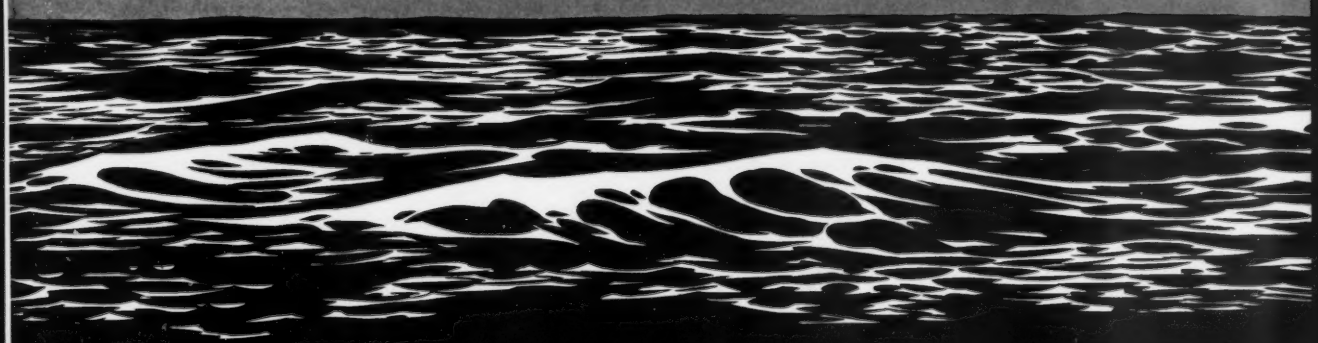
There are some quaint old expressions we can use at this point! "There's more than one way to skin a cat" and "You have to learn to walk before you can run." Applied to flying, both are filled with meaning. There *are* more ways to fly than just one, but you *do* need to learn one way first.

The next time you self-analyze your flying, ask yourself if you do something because you were told it was the best way, or because you've satisfied yourself that it really is. If you have an unvarying routine you go through on base leg, is it because the book says to do it or because it's a technique that suits you and helps you and serves as an assist to your timing and pattern adjustment?

It's possible to be mechanical, standardized and individualistic all at the same time. If it makes you a better, safer pilot, don't knock it, Buddy. Those million-mile airline pilots have been getting by for years that way.

crash sense

the following 28 pages prepared by the United States Army Board for Aviation Accident Research



DITCHING THE HUEY

Gerard Bruggink
Prevention and Investigation Division

A helicopter pilot who takes his emergency procedures seriously will be confused, to say the least, about the variety of ditching techniques in our different handbooks. Depending upon the type of aircraft he is flying, he may be told to roll it to the right when he hits the water, to roll it to the left, or to keep it level. What happens after the main rotor has stopped is completely left to the pilot's imagination, although most manufacturers suggest to abandon the helicopter expeditiously at this point. There is only one area where all handbooks agree: the helicopter has poor floating tendencies.

The reason for the meager ditching data in our handbooks may be the fact that the helicopter - as opposed to the fixed

DITCHING THE HUEY

wing aircraft—does not yield reliable data in scale model ditching tests, due to the many variables involved. The only alternative is to use the experience gained in actual helicopter ditchings to verify or update our prescribed procedures.

Statistically, the available data on Army helicopter ditchings can be summarized in a few sentences. During the past few years, 15 helicopters were involved in controlled or partially controlled water landings (inadvertent collisions with water are not included). Of the 60 occupants involved, three did not survive. Only one of these three drowned because he failed to evacuate the aircraft in time. (This occurred in a CH-34, presumably as a result of the blocking of the emergency exit by a troop seat.) No one was incapacitated as a result of the ditching itself.

To limit the scope of this article, and to avoid being accused of mixing oranges and apples, the ditching experience in only one type helicopter will be reviewed — the UH-1. However, by taking a close look at the ditching characteristics of the Huey, we cannot help but develop a better feel for helicopter ditchings in general. It is our contention that a pilot who understands the WHY of recommended procedures is in a better position to adjust himself to unforeseen circumstances than one who goes by the book, come hell or high water.

This discussion is based on four recent UH-1 ditchings. These four cases are unique in that they provide information which is beyond reach of a purely statistical approach to the problem. The members of the aircraft accident investigation boards who prepared the reports are commended for the thoroughness of their coverage of the ditching aspects, while the crewmembers involved deserve praise for their cooperation in the documentation and evaluation of their ditching experience.

A total of 26 occupants were involved in these four Huey ditchings (two Bravo and two Delta models). All of them evacuated the aircraft without major problems. Subsequently, three persons were struck by rotor blades, resulting in the death of one of them. One passenger drowned, after having been observed hanging onto the floating aircraft.

It will be noted that in case no. 1, the handbook instructions were followed to the letter (full right cyclic upon contact with the water). In case no. 2, the aircraft was rolled to the left. In the third case, the aircraft was allowed to settle vertically until it rolled to the left of its own accord. Partial loss of control (antitorque failure) in case no. 4 caused the aircraft to go in nose low on its right side. It is actually the difference in techniques used which makes a review of these four cases so interesting.

CASE HISTORIES

CASE NO. 1 (UH-1D)
Cause of ditching: Engine failure.
Nine occupants—eight survivors.

The aircraft was at 3,000 feet when the engine (bearing) failure occurred. An autorotative glide towards the coastline was started and the necessary emergency steps were taken (alerting passengers, transponder, mayday, etc.).

Aircraft commander (left seat): "We made it to about one-half mile from the shore before running out of altitude. I had alerted the crew to move all passengers toward the left side and to open the left main cargo door and to leave the right one closed. The pilot flared, zeroed out airspeed about two or three feet above the water, and applied full right cyclic. The aircraft went over nicely to the right side but then it came gently back [to the left]. At about that time, I was exiting the aircraft. I unfastened my seat belt, put my left hand on the door, and tried to jettison it. When this didn't work, I used the door handle (the seat armor panel was pushed back) and kicked it all the way open without difficulty. I took my helmet off as I was coming through the door, went into the water, and inflated

the only alternative is to use the experience gained in actual helicopter ditchings to verify or update our prescribed procedures.

my life vest underwater. As I was coming up (near the rear of the aircraft, the rotor was still very slowly turning and the aircraft kept rolling to the left, coming to rest inverted."

Pilot: "Over water, it is hard to estimate height, so I carried my glide speed (85-90 knots) down to maybe 100 feet. Then, I went ahead and started killing it off. I could probably have stretched the glide a little longer towards the beach, but it would have made only a few feet difference and I preferred to make a smooth touchdown.

"I started slowing up the airspeed and got into my deceleration attitude. I brought the nose up at about 50-75 feet and just held that position as I let it ride right on down to pitch pulling attitude, about 10 or 15 feet above the water. I pulled pitch like I always do and instead of bottoming out at the bottom, we just came into the water (it reminded me of being on water skis when you've already been cut off). We didn't have any forward motion and I could just feel us settling down in the water as I continued to pull pitch.

"It took quite a while for it to settle down and then I rolled it with full right cyclic. I think that the skids had just gone below the water when I rolled it (estimated bank angle 45°). The water was coming up on my window. I was still leaning over (to the right) and all of a sudden, we started coming back out of the water and rolling over the other way. My door came completely out of the water and I was looking up at the sky when I tried to jettison my door. I pulled the handle at least 6 to 8 inches and kicked the door, but it wouldn't open. (I hadn't slipped the seat armor plate back so I couldn't reach the door handle.) By that time, my head was under water and I turned and tried to dive out through the door on the other side which seemed to be straight down. I then realized that my seat belt was holding me. I flipped the catch up and then I just dived out. By the time I surfaced, the aircraft had turned or was completing its turn upside down. It floated upside down for what seemed like one to two minutes."

Crewchief: "The pilot told us that we were going down and to get ready to abandon the aircraft. I told the people that were sitting up front that we would be getting out on the left side. Everybody started taking off their boots, so I tried to take mine off and I got one off. The aircraft went in the water on its right side. As we started getting out on the left side, it started turning back into a regular (level) position. I was swimming away from the aircraft when I saw a blade coming at me and I tried to duck away from it but it hit me over the head. (Just before we hit the water, about four feet from it, I had unbuckled my seat belt and removed my helmet.)"

Accident board: "The actions of each occupant, in the order that they probably exited the aircraft, were as follows:

"1. Passenger (left rear seat) was ready to leap when first contact was made with the water. He made a strong, flat dive to the left of the aircraft, executed a few strokes, and turned around. He saw the aircraft in probably a 20° left banked position, and observed the main rotor blade slash into the water amid three or four persons in the water.

"2. Passenger (left side forward cargo compartment) braced and ready, made a flat dive shortly after the aircraft touched the water, and was observed by another passenger to be struck by the main rotor in the vicinity of his right ear. He was not seen after that, and is presumed dead.

"3. Crewchief (left rear passenger seat) exited the aircraft immediately, not with a dive, but just an entry, feet first into the water. He swam a few strokes, and heard and saw the rotor blade coming, and tried to duck away. The rotor blade did strike him on the top of his head as he dived away from it. When he surfaced, the rotor blade had stopped.

"4. Passenger (center forward in the cargo compartment) made a dive out the left door and soon

. . . a comparison of the UH-1 ditching techniques presently used by the three services shows that the U. S. Air Force procedure comes closest to a recommended technique.

caught sight of the rotor blade coming toward him. He dived down, but was struck on the left forearm by the blade anyway. While below the surface, he felt something nudge him, recognized it as the main rotor blade, and came back to the surface.

"5. Aircraft commander (left pilot's seat) opened his door, kicked it full open and exited to his left. He noted his helmet cord restraining him and removed the helmet. He finished the exit and noted the rotor blade still turning. He grasped the stabilizer bar, to push down and away from the blade, and this action took him back and over the tail boom of the aircraft. He then swam back to the left side of the helicopter to rejoin the others, inflating his life vest at about that time.

"6. Patient (on the litter) followed passenger no. 4 and was the one to observe the rotor blade strike passenger no. 2 on the ear, as well as seeing it hit the crewchief. He elected to dive deeply. He surfaced shortly and discovered he could swim, although he had never swum before in his life.

"7. Passenger (seated to the right of the patient on the litter) followed the patient out, but didn't move away from the aircraft. He clung to it, and climbed up on the skid to remove his boots, but the aircraft sank before he had time to get them off.

"8. Passenger (right rear passenger seat) finished removing his boots after contact with the water and when he began his exit, the aircraft had rolled considerably to the left and was filling with water rapidly. He considered making his exit through the escape door in the right cargo door, but decided it would destroy the air pocket of trapped air, so he dived down and out the left side, which was under water at the time. He surfaced uneventfully.

"9. Pilot (right pilot's seat) concerned himself with the controls and observed his door go down into the water as he rolled the aircraft to the right. Then he watched his door come up out of the water, and decided to exit through the right pilot's door. He pulled the emergency handle, but the door did not jettison. He then tried to kick it out, but to no avail. Water was filling the cockpit by then so he unbuckled his safety belt and dived down and out the left pilot's door."

CASE NO. 2 (UH-1B)

Cause of ditching: Engine malfunction.

Six occupants—six survivors.

Pilot (left seat): "When we were about 20 feet above the water, I flared. I slowed it down as near to zero as I could and, at about this time, the tail boom made contact with the water. I pulled in collective and let the aircraft settle into the water. When I pulled collective, the ship started to turn to the right slowly, but stopped as the body of the aircraft contacted the water. After contact was made with the water, I held the pitch up, allowed the rotor rpm to die down and then rolled the ship to the left. The initial blade strike with the water caused the ship to lurch to the left but after that it didn't seem to cause much movement. All of the passengers were out of the rear (right cargo) door by the time we rolled it. The copilot opened his door (right cockpit) and dived well clear of the aircraft. I unsnapped my belt, stepped into the back of the aircraft, threw out a life preserver, took off my helmet, stepped out onto the skid and shoved away from the aircraft. The main rotor blade was making its last revolution at this time. When I looked back, the aircraft had sunk out of sight."

Copilot (right seat): "Our aircraft encountered a severe vibration and started a dive to the left. I immediately got on the controls with the pilot because the aircraft seemed to be out of control. We managed to regain control after the airspeed had increased from 90 to 115 knots and lost approximately 1,000 feet of altitude. We then eased back on the cyclic and decreased collective. At this time, we lost rpm so the pilot entered autorotation. He attempted to make a left turn to reach the shore, but was unable to do so without increasing the vibration.

"The pilot instructed the crewchief to close the left cargo door and to keep the right door open. When we were about 20 feet off the water, he entered a steep flare, stopped all forward airspeed, pulled pitch and settled in the water. After the rotor rpm had decreased, the aircraft was rolled to the left and the crew started evacuating through the right cargo door. I then unbuckled and exited through the pilot's door.

"The aircraft stayed afloat for about 45 seconds and then sank. We had life preservers for everybody and were thrown some more by our chase aircraft."

CASE NO. 3 (UH-1D)

Cause of ditching: Partial engine failure.

Seven occupants—six survivors.

"The surf was quite heavy at the time of the ditching, with waves about seven feet high crashing into the rocky coast. The ditching was smooth and the aircraft remained upright momentarily with the main rotor turning. As it began to sink, waves coming from the right rolled it over on its left side, causing the main rotor to strike the water. (Both cargo doors had been removed before takeoff.)

Aircraft commander (left seat): "Our touchdown was slightly tail low, five knots or less forward speed, 5400-5600 rpm and 10 pounds of torque. Just prior to touchdown, I jettisoned my door and yelled for all passengers to jump out. We submerged on impact, and I remember only a very heavy jolt while under water. The ship then rose above the water and then we submerged again."

Pilot (right seat): "We executed a very slight flare and, as we touched the water, I noticed the engine rpm pass through 5800. After touchdown in the water, I unfastened my harness and exited through the left cabin door."

Crewchief: "There was no shock or anything as we set down, and the ship started sinking gradually. I was waiting for the rotor to stop when a wave came over the tail boom forcing the ship forward and onto its left side. I was thrown out and under water and was trying to grab something when I found myself out of the water holding onto the transmission."

EXTRACTS OF UH-1 DITCHING PROCEDURES (POWER OFF)

	CONFIGURATION	TOUCHDOWN
U. S. ARMY (TM 55-1520-210-10)	**Close right hand doors and pilot's window. Jettison copilot's door and slide left cargo door full open.**	**As the tail contacts water, apply full right lateral cyclic control to roll the helicopter on the right side.**
U. S. NAVY (NAVWEPS 01-110-HCA-1)	**Open cargo doors.**	**Upon contact with the water, continue to increase collective pitch to slow rotor blades and roll aircraft to the right. Apply rotor brake.**
U. S. AIR FORCE (T.O. 1H-1UF-1)	**Jettison cockpit doors, slide cargo doors full open.**	**After contact with the water, increase collective pitch as the helicopter settles. Maintain a level attitude as long as possible.**

. . . the only personnel with evacuation problems were some of the pilots. Two left the aircraft through the door window while underwater . . .

Gunner: "I did not have a flak jacket nor a life preserver. The crewchief removed his chest protector and put on his life preserver. I unfastened my seat belt and started untying my boots which I did not finish. I looked unsuccessfully for a wooden box to use as a float. When the aircraft was about six to eight feet above the water, I jumped out through the right door with my rifle and overnight bag. I stayed down until I figured the blades had stopped turning or had cleared me, then I surfaced. I was about 60 yards from the aircraft. Pieces of the aircraft flew toward me."

Passenger: "The crewchief gave a signal that we were going down and I saw him remove his chest protector, and pull a life vest from under his seat. (I did not have a life preserver.) It looked as if the pilot was trying to reach a sandy beach ahead. We landed gently into the water about 100 yards short of the beach and about 10 to 15 yards from some rocks. Prior to touchdown, the gunner jumped out of the right door. The aircraft settled vertically into the water and I jumped out of the right side."

Accident board: "Emergency ditching procedures (according to handbook) could not be carried out because both cargo doors had been removed prior to flight. Consequently, the aircraft was kept upright and immediately began to sink. With the exception of the gunner who jumped from the aircraft before touchdown, the crew and passengers exited through normal exits without problems, except the aircraft commander who was momentarily pinned in as he attempted to exit. Though the crewmembers were carrying life vests, they were either discarded or never inflated. The passenger, who drowned after he evacuated the aircraft, did not have any flotation gear, nor did he make an effort to let go of the sinking aircraft. He was last seen hanging onto the tail stinger.

"It is the opinion of the board that the correct decision was made by not rolling the helicopter (to the right) in view of the cargo doors having been removed."

CASE NO. 4 (UH-1B)

Cause of ditching: Antitorque failure during take-off from ship.

Four occupants—four survivors.

Pilot (right seat): "After clearing the ship's deck, the aircraft continued to turn another 90° and made contact with the water. I applied full power and the aircraft came out of the water momentarily, did another 90° turn and struck the water again in a right side and nose low attitude.

"The aircraft started to sink immediately, so full right cyclic was applied to stop the main rotor and allow the crew to evacuate the aircraft. When the rotor struck the water, the cyclic went hard to the

rear causing my arm to strike the seat armor. The aircraft was completely submerged within seconds, at which time I released by seat belt, remembering I had to wait till the rotor had completely stopped before I got out.

"The aircraft sank on the right side. I tried to get the chest plate off, but the cloth was too slippery to grasp and the fasteners at the shoulders too hard to pull apart. (My life preserver was sitting right next to my seat, but I forgot about it.) I figured I'd better get out before the aircraft touched down on the right side (shallow water) or I would have to try to get out of the open cargo door. I could not get the door to jettison in my first two attempts, so I went out through the pilot's window. I put my hands on the outside of the window and pulled myself through, facing upside down (with armor on). I am six feet, one and one-half inches tall and weigh 200 pounds."

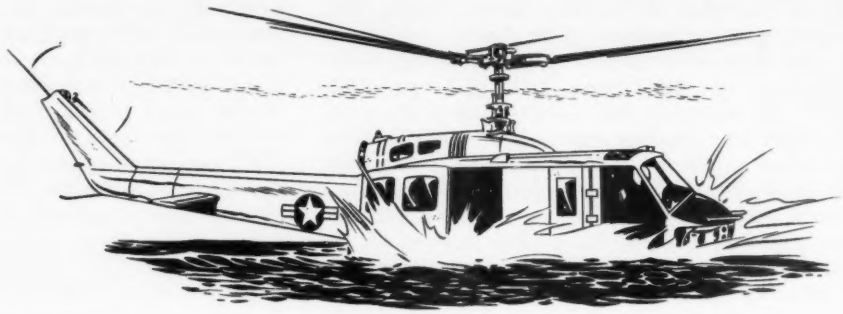
Copilot (left seat): "Contact with the water was made in level attitude. Collective pitch was applied and the skids came out of the water, with the aircraft still spinning to the right. I would estimate the helicopter was about five feet high at this point. Then it started settling in a right nose low attitude. I was reaching for the cyclic, trying to help the pilot to ditch it, when the right rotor blade hit (we lost practically all rpm at the first blade strike and the aircraft gave a violent jerk). The cyclic was forced from my hands. I tried to push the cyclic to the right as far as I could with my left hand.

"The aircraft rolled over on its right side and gave a couple of jerks when it hit the water. The rotor blade struck again and we sank immediately, before I could reach for the door jettison handle. I was halfway submerged before I could touch it. By the time I pulled, I was completely submerged and the door would not jettison.

"I unfastened my seat belt and got out of my seat. On my right, I saw the pilot getting out. I looked into the cabin, but could not see what was going on. I don't know if the water wasn't clear enough to see, or if they (the passengers) were out, or what. Then I tried to go through the window. Evidently, the cord on my helmet caught, pulling my helmet off. I slid the rest of the way through the window and swam to the surface."

Crewchief: "The aircraft appeared to be out of control and continued to spin towards the water. I held onto my seat belt until the aircraft struck the water and then released it. By this time, the helicopter had submerged, so I swam to the surface."

DITCHING THE HUEY



Gunner: "The next thing I knew, we were going around in circles and hit the water on the right side. I was partially thrown out but was held by my seat belt. I released the seat belt and swam to the surface where we were picked up by a patrol boat."

DISCUSSION

Without implying that these four cases cover every possible contingency, they present such a broad cross-section of the problems to be expected in Huey ditchings that certain conclusions and speculations seem justified.

Aircraft configuration. In all cases, at least one cargo door was open and all cabin occupants evacuated through these doors without difficulty. The handbook procedure which calls for closing the right cargo door and opening the left one could have been catastrophic in case no. 1, when the aircraft rolled unexpectedly from right to left. Premature evacuation of the passengers offset the effects of this roll-over, but that in itself introduced another hazard – rotor blade strikes. To preclude evacuation problems and the effects of disorientation, aircraft gyrations, and poor visibility in murky water, it seems advisable to slide both cargo doors open prior to ditching, especially in the D model.

The only personnel with evacuation problems were some of the pilots. Five of them attempted to jettison a cockpit door, but only one was successful (this was the pilot who jettisoned his door just before touchdown). Two pilots left the aircraft through the door window while underwater, which speaks more for their will to live and agility than the reliability of the door jettison mechanism. Even if the release mechanism operates properly the door cannot be removed until the water pressures on both sides of the door are practically equal. Since the armor plates on the crew seats make it difficult to operate the door handle, or to enter the cabin area and leave through the cargo door, it might be better to jettison both doors just prior to touchdown, rather than the left door only as recommended in the handbook.

The alternate method to insure an easy way out is to open the door in the normal way, turn the handle into the locked position with the door still open, and leave it alone. This action will keep the door ajar and outside the door frame so that jamming as a result of fuselage distortion is practically impossible. If it doesn't open itself during the ditching, all the pilot has to do is press against it. If nothing else, it will make it easier to jettison the door once the aircraft is in the water. This procedure, which can be used at any time during the approach, is a variation on the old method of keeping the cockpit door ajar by means of a piece of cloth, a book, or a map between the floor and door bottom.

Passenger preparation. Ideally, every helicopter passenger should have the benefit of a briefing on ditching procedures prior to overwater flights. Even more important, every occupant should have a life vest and know how to use it. Unfortunately, a tactical situation may force us to compromise our good intentions, although there is never an excuse for lack of crew training and leadership. In one of the four cases, the aircraft carried an overwater survival kit, but the crewchief forgot to take it out. Another

. . . the aircraft should be kept level while letting it settle vertically into the water and gradually applying all available pitch. This is the most critical moment as far as cabin discipline is concerned . . .

crewchief released his seat belt and discarded his helmet before the ditching.

The most important man in the cabin during an emergency situation, such as an anticipated ditching, is undoubtedly the crewchief. It is his responsibility, after getting the word from his pilot, to take charge and prepare his passengers as time permits. He should pay particular attention to seat belt restraint, use of life vests, discarding of obstructive equipment (armor, backpacks, etc.), opening of cargo doors, and instructing the passengers to stay in the aircraft until the rotor has stopped. If occupants start to evacuate before the rotor has stopped, the crewchief should advise them in a firm manner to stay close to the aircraft, well inside the rotor blade danger area.

Crewmembers should not feel embarrassed about wearing a life vest, even when none are available for the passengers. A life vest puts them in a better position to assist passengers during a ditching. Nonswimming crewmembers and passengers should have priority in the distribution of life vests. All occupants should be cautioned against inflating life vests while still in the aircraft. This could jeopardize timely evacuation, in case the wearer has to dive to leave the aircraft. Helmets and boots should not be removed until clear of the aircraft.

Touchdown. It speaks for itself that the actual landing should be made as smoothly as possible, with zero forward groundspeed. A gentle touchdown precludes incapacitation of the occupants or fuselage damage which might affect flotation time and the operation of exits. Negligible forward velocity will also prevent the cargo doors sliding forward and closing. If the water surface is smooth and no other reference points are available, it might be advisable to drag the aircraft in tail low to compensate for possible errors in judging distance from the water. However, the pilot should realize that a tail low attitude may result in loss of antitorque control before the main fuselage has acquired sufficient directional stability as a result of water contact. For this reason, it seems best to set the aircraft down in a near level attitude, especially in power-on ditchings.

The differences in control techniques used after first contact with the water in the four cases make it difficult to proclaim one of them as superior. Based on the available information in the accident reports, the procedures used in case no. 1 came closest to the recommended handbook technique (full right cyclic as the tail contacts the water). As a result, the main rotor struck the water at relatively high rpm and the aircraft tilted from right to left. To what extent this reversal of bank was the result of the blade strikes or the passengers moving to the left side of the aircraft is difficult to say.

Before venturing an opinion as to the best possible technique, a closer look must be taken at the heart of the helicopter ditching problem—the need to delay evacuation until the main rotor has stopped. Since the rotor can be stopped only by water contact, it follows that at least part of the fuselage will be submerged by that time. To reduce the violence of the rotor strikes and prevent the blades from skipping off the water and reversing the direction of roll, rotor energy should be dissipated as much as possible before blade contact with the water. This implies that the aircraft would

have to be kept level while letting it settle vertically into the water and gradually applying all available pitch. This is the most critical moment as far as cabin discipline is concerned, since the temptation will be strong to leave the aircraft at this point. Having both cargo doors open at this time has three advantages:

It makes it easier to let the aircraft settle vertically due to the symmetrical inflow of water.

It counteracts the rotor's tendency to tilt the aircraft in the opposite direction since the floor on the low side is "digging" into the water.

It practically precludes evacuation problems regardless of the aircraft's attitude.

Towards the end of the pitch pull, the aircraft will tend to roll over as a natural result of the weight and buoyancy distribution along the vertical axis (engine and transmission are located above the areas that provide flotation: fuel cells and trapped air in fuselage bottom and tail boom.) When it is obvious in what direction the aircraft will roll, the pilot should assist by applying full cyclic in the same direction. The roll may continue until the aircraft stabilizes in an inverted position. There is no reason to assume that the aircraft will sink like a rock unless an extremely hard touchdown caused extensive fuselage damage.

In rough water, the waves may induce the early rolling tendency, or they may contact the rotor blades before the aircraft starts rolling. In both cases, the rotor-stopping process will be expedited. Regardless of the rpm at which this occurs, the aircraft may be jerked violently. For this reason, restraint systems (seat belt and shoulder harness) should not be released until the rotor has "died." An additional advantage of closely following the aircraft's gyrations is the fact that the occupants will not become disoriented. An exit which is on a passenger's right side will still be on his right side, if he doesn't release his seat belt until it is safe to leave the aircraft.

CONCLUSIONS

A comparison of the UH-1 ditching techniques presently used by the three services (see table) shows that the U. S. Air Force procedures come closest to a recommended technique based on actual ditching experience. Without implying that the present TM 55-1520-211-10 ditching procedures are inadequate or hazardous, it is suggested that the following recommendations be used to review and update these procedures:

DITCHING—POWER OFF

Aircraft Configuration:

1. Slide both cargo doors full open.
2. Jettison both cockpit doors —starting with the right door. This recommendation should be viewed with reserve. No assurance can be given that a jettisoned cockpit door will clear the tail rotor. (Contact with the main rotor is not considered critical. In several instances, loose cargo doors and transmission cowlings have struck the main rotor without affecting the control of the aircraft.) It appears that the chances of fouling the tail rotor are greatest when jettisoning the left door since it is located on the same side of the aircraft. For this reason, it seems best to jettison the right door first and to delay releasing the left door until the aircraft comes to a hover. If circumstances do not permit this course of action, the pilot in the left seat should at least lock his door handle in the open position and lower the door window.
3. Slide the seat armor back.

Passenger Preparation (crewchief's responsibility):

1. Discard all obstructive equipment (armor vests, backpacks, etc.).
2. Secure all protective equipment (seat belts, helmets, life vests, etc.).
3. Remind passengers to stay in the aircraft (secured) until evacuation signal is given or rotor has stopped.

Touchdown:

1. Execute a flare and approach the water in a near-level attitude.
2. Aim at a zero groundspeed touchdown.
3. Upon water contact, continue to increase collective pitch.
4. Maintain a level attitude as long as possible, while the aircraft settles into the water.
5. As soon as the aircraft shows a tendency to roll in one direction (at the end of the pitch pull), assist it with lateral cyclic in the same direction.
6. Do not start evacuation until aircraft has definitely rolled to one side and the rotor has stopped.

DITCHING—POWER ON

The procedures for a power-on ditching are essentially the same as those for a power-off ditching with the following differences:

1. Evacuate all cabin occupants while at a hover.
2. Hover a safe distance downwind, turn one side of the aircraft towards the evacuees and shut the engine down.
3. Follow the power-off ditching procedures.

TIGER BY THE TAIL

Ted Kontos

We laugh at the ad which urges, "Put a tiger in your tank!" But when we handle gasoline, we are literally holding the tiger by its tail. If it gets loose, look out!

RECENTLY, an airplane was landed in an open field after exhausting its fuel supply. It was not damaged and gasoline was delivered to the site so it could be flown out. During servicing, a plastic funnel was used. The result was an electrical spark which ignited the fuel, destroying the aircraft. Similar fires have occurred while filtering fuel under pressure through a chamois, even though metal funnels were used.

Although fire is the principal hazard associated with fuel, it is not the only one. Mechanics have developed severe infections from frequent or prolonged skin contact with it. Others have been overcome by its vapors, and accidental swallowing has caused deaths.

We are closely associated with gasoline in our daily lives. We use it to power our automobiles, boats, lawnmowers, tractors, and other equipment. We also use it for starting fires, cleaning parts and machinery, washing floors, shop towels, work clothes, and our greasy hands. We haul it in our cars and boats, and store it in our homes. We use and misuse it in a great variety of ways. We laugh at the ad which urges, "Put a tiger in your tank!" But when we handle gasoline, we are literally holding the tiger by its tail. If it gets loose, look out! Let's see why.

Gasoline is a fuel designed to produce power within an engine. To function efficiently, it must be able to change readily from its liquid state to a vapor which can easily be ignited. It must, then, be highly volatile—and it is. Take a look at an ordinary one-gallon can used to store gasoline for the power mower. As the temperature rises during the day, the walls of the container begin to bulge, even though it is not full. If the lid is slowly loosened, a hissing sound can be heard as vapors escape and pressure is equalized. When you tighten the lid again, it causes the cycle to repeat itself.

TIGER BY THE TAIL

...gasoline possesses nearly 64 times the destructive power of dynamite...and no fused charge is needed to set it off.

These vapors are highly flammable, heavier than air and, in the absence of air currents, tend to accumulate along the ground. Since they are surrounded by air, an ample supply of oxygen is available for combustion to occur. All that's needed is a source of ignition.

When gasoline vapors ignite, a vast amount of energy is released. Pound for pound, gasoline possesses nearly 64 times the destructive power of dynamite—one gallon having the potential equivalent of over 400 pounds. And, unlike dynamite, no fused charge is needed to set it off. Any source—open flame, heated object, or spark—can do the job.

In addition, gasoline and its vapors are highly toxic. This toxicity level is further increased by fuel additives which are more toxic than the fuel itself. Certain bacteria, for example, thrive in unleaded gasoline, but die when lead is added. Gasoline not only dissolves grease, but also reacts chemically with numerous other compounds, adversely affecting a variety of plastics. Being lighter than water, it floats when the two are brought together. Understanding these properties is a necessity if accidents are to be prevented. Considering the thousands of gallons which are handled daily at airfields all over the world, preventing such accidents is a major concern.

PREVENTING FIRE

If gasoline could be isolated from any oxygen source, vaporization prevented, or its vapors always diluted sufficiently with air, combustion could not occur. In practice, it is not normally possible or practical to do any of these. But we can, to a limited degree, control them by confining gasoline in approved tanks or containers, providing ample ventilation, and maintaining its temperature as low as possible.

Approved fuel containers include aircraft fuel cells, permanent storage tanks, fuel trucks, railroad tank cars, steel drums, etc. Because they are easily broken, glass containers should not be used for storing even small amounts of gasoline. Unless specifically authorized, plastic containers should not be used, as most plastics deteriorate from prolonged contact with gasoline, and many are flammable.

When gasoline is stored in sealed containers such as steel drums, vapors are trapped, isolating them from ignition sources. However, if these drums are subjected to heat, fuel will expand and vaporization and pressure buildup within the drums will increase. Should the drums get hot enough, they may explode violently, spewing flaming fuel over a wide area. To prevent this, the following precautions should be followed:

Leave an expansion space when servicing containers.

Store in a well ventilated area, away from potential fire or other heat sources.

Shade from direct sun rays, particularly during summer months in hot climates.

Handle with care to prevent damage which may result in leaks.

Inspect periodically to ensure against leakage.

In fuel systems, such as those found on aircraft and at permanent fuel storage areas, vapors are vented overboard, preventing pressure buildups within the cells or tanks. However, these vapors are not diluted enough to prevent combustion until they are some distance from their outlets, and their dispersion depends on air currents. In confined areas, such as hangars, and during servicing operations, the fire hazard increases because of an increase in the amounts of fuel and vapor available for combustion. Our limited control over gasoline and its vapors during handling and storage is not enough to prevent fire accidents. *We must also eliminate all possible ignition sources.* These are many and varied, but they can be grouped into seven basic categories: open fires or flames, including incandescent lights; heated objects; static electricity; current electricity; high energy radiation; sparking from nonelectric causes; and spontaneous combustion.

Open fires and flames include such obvious sources as lighted lamps, matches, and gas welding torches, as well as backfiring and afterburning of engines. Accidental breaking of photo-flash bulbs as well as incandescent bulbs, including those in flashlights, provides equally dangerous ignition sources. So do heated objects, particularly if they are heated to incandescence. Examples of these include exposed electric heating elements, lighted cigarettes, and glowing particles from chimneys and engine exhausts.

Sparks caused by static electricity are a prime cause of fuel fires. Such a spark is generated when surplus electrons from one object jump to another object with an opposite charge. The most vivid example of this is seen during thunderstorms when lightning arcs between two clouds or between a cloud and some object on the ground. On a much smaller scale, the same thing occurs when you slide across the car seat and then touch the door or some other metal portion. Static charges can be built up in various ways, such as movement of aircraft, fuel trucks or other vehicles; fuel flowing through a servicing hose, plastic funnel, or chamois; rubbing wool, silk, or synthetic fibres; or agitation of petroleum liquids. Even the air flowing over parked aircraft, vehicles, and other equipment can build up a static charge.

Sparks from current electricity are equally as hazardous. They occur when an electrical circuit is short circuited. They also occur *anytime a completed circuit is broken.* This is true whether the circuit is broken by the operation of a switch, the rotation of a commutator segment away from the brush inside a generator, or when an extension cord in use is unplugged. This means that arcing occurs continuously within the housings of electric generators, inverters, induction vibrators, all types of electric motors, distributors, magnetos, etc., when the equipment is operating.

Another ignition source is provided by high energy radiation, such as that emitted by operating radar equipment. Although invisible, this energy is powerful enough to fire nearby flash bulbs.

Sparks from nonelectric causes result when metal strikes metal or some other hard or abrasive surface. Such sparks are seen during hammering or grinding operations. The accidental dropping of tools, the use of steel taps on shoe toes or heels, or dragging items such as metal buckets or steel drums can cause similar sparking.

Poor housekeeping leads to another ignition source—spontaneous combustion. When fuel or oil soaked rags are piled together or confined, they begin to generate heat. Over a period of time, this heat can reach a temperature at which flammable vapors will ignite.

To prevent gasoline fires, ignition sources of all types must be understood and prevented. The following DO's and DON'T's serve as a guide:

DO

Use approved safety light (including flashlights) around fuel. Ensure that all airfield vehicles and other motorized equipment are properly equipped with approved type flame arresters and that these are in serviceable condition.

Maintain exhaust systems of airfield vehicles and other motorized equipment in serviceable condition.

Ensure that aircraft and other ground wires are clean, free from paint and corrosion, and serviceable.

Ground all aircraft in hangars, shops, etc.

Ground aircraft, fuel trucks, or other type servicing equipment, including fuel hose nozzles, before servicing aircraft.

Discard fuel and oil soaked rags in metal containers which are partially filled with water and which have metal lids, preferably the self-closing type.

Use only nonsparking tools in areas where gasoline vapors are present. Smoke in designated areas *only.*

DON'T

Permit fires or open flames around aircraft, fuel carriers, storage tanks, etc.

Continued on page 55

pearls

personal equipment and rescue/survival lowdown

Dear Army Aviation Crewmembers:

As I promised last month, here is the latest lowdown on NOMEX flight suits, as of 7 March 1967. I will be writing about two separate NOMEX suits. The first was to have been an interim flight suit until the Small Development Requirement (SDR), "Clothing System for Aviation Crewmembers," was completed. The second suit I will discuss is described by the SDR.

The interim flight suit was developed by the Navy's Aerospace Medical Research Department, U. S. Naval Air Development Center, Johnsville, Pa. This suit is made of a polymide fiber (NOMEX), developed by DUPONT, that is permanently fire retardant. Flight suits made of NOMEX were compared with flight suits of different flame retardant treated fibers by mounting them on leather-covered dummies and pulling them through an inclosure in which 50 gallons of aviation gasoline was ignited. The duration of exposure to the flames was approximately four seconds. Without going into all the technical details, a double layer of NOMEX reduced the amount of severe burns from approximately 57 percent of the body area (probably fatal) to 2 percent of the body area. However, the double layer, when evaluated in a hot humid climate, proved to be too uncomfortable.

The Navy has settled on a single layer of NOMEX. This provides as much protection as a fire retardant treated cotton fiber flight suit. However, NOMEX has the advantage of being permanently fire retardant, and it is more durable than cotton. The cotton flight suit has to be retreated after *every* washing or after 15-20 washings, depending on the type of treatment. This NOMEX flight suit has been adopted by the Navy as standard issue.

During 1965, representatives of the Army met with the Navy to ascertain if the Navy would agree to certain modifications that would meet the needs of the Army for an interim flight suit. Two of the main modifications agreed on were to make the collar similar to the Army fatigue collar and to provide a double layer of NOMEX down the back of the flight suit. USABAAR studies have shown that this was the area most susceptible to burns when an individual has to run through flames.

The Army then constructed 100 modified NOMEX suits for evaluation in Vietnam. While this evaluation was underway, it was recommended that the NOMEX flight suit be adopted by the Army until the SDR for flight clothing was completed, as there were no fire retardant flight suits, except for the International orange, in the Army system. Before this recommendation could be acted on, the USARV preliminary evaluation arrived, stating that the modified NOMEX suit was too hot, itchy, and had bad fading characteristics.

DUPONT then improved the fiber and made a new weave to correct these deficiencies. The U. S. Air Force is purchasing 500 of these single layer improved flight suits.

There is some doubt about the course the Army will follow. Reportedly, 100-200 improved suits will be sent to USARV for further evaluation. These will be in various configurations, one-piece, two-piece, single, and double layer garments. However, in place of NOMEX, the latest message from DA favors using the borax treatment until the SDR has been developed. I am including the borax treatment in this issue.

The SDR is presently under development and the first prototypes have been made (see photo). It is a single layer, two-piece garment. The two-piece configuration has been established. Whether or not it will be a single layer, double layer, or one and one-half layer (double layer down the back), will depend on the testing and development phases. The prototype is made of NOMEX. However, this may be subject to change.

The blouse is designed to look like the standard utility blouse. The only difference will be sleeve pockets, one on each sleeve, similar to those on the present K-2B flight suit. The trousers have standard utility trouser pockets, both hip and side, as well as thigh and lower leg pockets. In addition, there is a separate side pocket for the standard survival knife. Under the test and development plan, this

flight suit is scheduled for type classification during the first quarter of FY 1969, about 15-18 months from now. After that, the suits must be manufactured in sufficient quantities before they will reach you.

Since the February issue, I have received many letters asking about the pen gun flares. I have answered all of these letters with the information I gave in the April issue.

Dear Pearl:

. . . We in the Aircraft Maintenance and Supply Technical Assistance Office were happily surprised when we noticed that the AVIATION DIGEST is allowing space to talk about survival equipment in the February 1967 issue.

During the past year or so this command has noticed a need of help insofar as publications concerning survival equipment is concerned. We have been beating the bushes around Army aviation circles, trying to get someone to do something about this much neglected subject. . . .

This letter is really to congratulate the editorial staff for allowing space for one of the most important subjects related to flying.

First, we would like to know what publication authorizes the use of pen guns and flares in U. S. Army aircraft. Are these guns and flares in your article going to replace presently installed signal, smoke and illumination, MK 13, MOD O in survival kits covered in Military Specifications MIL-S-18655, MIL-S-43301, MIL-S-43423, MIL-S-43428, MIL-S-43457, and other applicable specifications? If not, has some kind of publication been issued to specify use, inspection, etc.? The answers to above questions are needed to improve the existing survival program in Alaska.

As you probably know, existing technical manuals applicable to upkeep of survival kits used in aircraft are in much need of revision or replacement. This command has recommended, through the use of DA Form 2028 . . . that TM 1-1-1-641, "Minimum Equipment for Overwater, Arctic and Desert/Tropic Flights," and TM 1-14S1-3-51, "Base Assembly, Use and Maintenance of Sustenance Kits" be updated to . . . include Army terminology. This will include command responsibilities, types of equipment used, reference material, and aircraft involved. Neither of the above mentioned manuals include survival kits for Army aircraft in use today, nor the latest federal stock numbers, inspection procedures, or replacement criteria for certain components in kits. These manuals do not contain minimum requirements for inspection of survival kits in use today.

Replies to DA Form 2028 concerning updating

the NOMEX flight suit is permanently fire retardant and has been adopted by the Navy as standard issue.

or supercession of TM 1-1-1-641 were received from AVCOM, and they will issue a Technical Bulletin No. 55-1500-204-12, "Minimum Equipment Requirements for Overwater, Arctic and Desert/Tropic Flights." Estimated publication date is 1 May 1967. The reply to DA Form 2028, concerning updating of TM 1-14S-13-51, has not been received. This technical manual should prescribe the use and maintenance of sustenance kits in U. S. Army aircraft. If this manual is not updated, our flying and maintenance people will still be in the dark. . . .

. . . let me point out something concerning your second article when the aviator was down at sea. He had a life vest. Where was his survival kit? If he had one, and if it was the proper type and up to date, there should have been two signals, smoke and illumination, which require no gun. I agree with you that units should ensure that all Army crewmembers are thoroughly familiar with all of their equipment, but how can the units properly conduct a complete program without printed publications applicable to the use and maintenance of personal and survival equipment? Of course, I agree with you, if he left his survival kit back home, it would do him no good in the water.

In conclusion, let us thank you and the staff for the space in the DIGEST to be utilized for an important subject. . . . We solicit your help in providing us with articles or any other kind of help which would result in better use and maintenance of survival equipment. . . .

William D. Waldrop
Aircraft Equipment Specialist
Hq, U. S. Army, Alaska Support Command

Dear Mr. Waldrop:

Thank you for your letter of 20 February. The PEARL column will continue in the AVIATION DIGEST as long as there are people interested in the subject of personal, survival, and rescue equipment.

A technical manual is being written by AVCOM covering maintenance of survival kits, life rafts, life preservers, etc. The first one (covering OV-1 survival kits) should be issued in the near future.

The pen gun flare will not replace the MK 13 MOD O smoke and illumination signal. The pen gun flare kit will supplement the survival kit. It is designed to be carried in a pocket of a flight suit or fatigues. I know of no plans for a TM. The device is very simple and should require little or no maintenance. The flares supposedly have a shelf life of two years.

Survival courses are available for Army personnel. There is a short "briefing" type course at Fort Rucker. However, the Air Force has several schools covering desert, jungle, and water survival training. It should be no problem to send selected individuals to these courses and then establish your own course, using these people as instructors.

The aviator who crashed in the water after takeoff (Aviation Digest, Feb 67) did have a survival kit in the aircraft. Whether it was the large kit with the MK 13 MOD O signal is unknown. If it was, the aviator probably did not take it with him when he evacuated the aircraft. USABAAR files have many cases where the people evacuated the aircraft, but left their survival equipment. If the kit is not attached to the person, this will usually be the case.

PEARL

Dear Pearl:

I am writing for your ideas and suggestions regarding aeromedical evacuation peculiar to Alaska. I will first explain our situation.

Normally, Air Force, Air-Sea Rescue provides aeromedical evacuation for all required emergen-

FIRE RETARDANT PROCESS

1. Clean flight suit or fatigues by washing with detergent, damp dry, using spin cycle.
2. While still damp, submerge and agitate 10 minutes at 100°F in the following solution:
   - 6 gallons of water
   - 2 pounds of borax (FSN 6810-264-9056)
   - 1½ pounds of boric acid (FSN 6750-174-5454)
   - 1½ pounds of ammonium phosphate, dibasic (FSN 6810-264-6547)
3. Hang to dry or iron with warm iron (250°F). Do not dry in automatic dryer.

Fire retardant qualities are lost with each washing and must be repeated.

What was to have
been interim suit

cies. However, during field exercises and maneuvers the responsibility for evacuating participating ground troop casualties rest with the USARAL Surgeon. On these occasions, the capabilities of this office are rather limited. The aircraft, CH-21s, for a situation of this nature are provided by a separate unit—the 19th Aviation Battalion. These aircraft are not equipped with emergency medical equipment or medical personnel. The situation is further compounded by small units operating over a large, extremely rugged land mass. Visibility is made difficult by ground fog, ice fog and a condition called "white out." These adverse conditions are further complicated during the hours of darkness. All of these conditions, when framed against a background of ambient temperature which ranges to —60°, accentuate the problem area.

What I feel we need is portable equipment—a simple but workable alerting system and some means by which small, isolated units can signal rescue aircraft.

Any and all comments and ideas would be appreciated.

SGM Gerold Thompson
Officer of the Chief Surgeon
Hq, U. S. Army, Alaska

Dear SGM Thompson:

In answer to your letter regarding simple portable alerting systems by which small isolated units can signal rescue aircraft, I suggest the Survival Radio AN/URC-10. This radio is UHF and is a Standard A item of issue. The AN/URC-10 is a single unit, battery operated transmitter/receiver unit with NDB capabilities (beep for homing); however, Army aircraft cannot home on this radio. Air Force pilots presently carry this radio in a special vest or in a pouch which may be strapped to the leg.

The radio is ordered in two parts: RT-278/URC-10, Survival Radio FSN 5820-985-9016 and Battery, BA 1387, FSN 6135-889-1485.

Further suggest you contact either Mr. Ferdinanz or Mr. Bob Patterson who are the Electronic Command representatives at Fort Richardson, Anchorage, Alaska, SCAN 817-862-8213 or 817-863-4180. These people are there to give communications assistance to line troops, etc., and are experts in that

Prototype of SDR suit

field. They will be well acquainted with problems in this area.

I am sending you a copy of my April article telling how you can get pen gun flares, another means for signaling rescue aircraft.

PEARL

Dear Pearl:

The U. S. Navy has some mighty fine thoughts about how to take care of their aviators. Like, for example, providing protective helmets with earphone cushions which are COMFORTABLE. A description of the "comfort level" of the Army's APH-5 earphone cushion might be censored by your editor, so I won't bother to put it on paper. The Navy version fits OVER the ear, and can be worn for hours on end with no sweat. But the Army earphone cushion, being too small and too shallow for anything but a midget, fits on TOP of the ear of many an aviator, quickly giving rise to distracting discomfort. Sound attenuation is also probably better with the Navy model, since it is not held away from the head by a protesting Army-type ear.

This Navy earphone cushion, *appears* to be interchangeable with the Army type, i.e., can be installed in the Army APH-5, using the same earphones, wiring, etc. There have been rumors that the Navy type cushion is available through Army channels, but so far I haven't been able to find out how or where.

Naturally, we think the helmets should come from supply already wearing the better cushion, but since they don't, can you help us locate a source of them?

CPT N. Bruce Chase, MC, AMO
Aviation Medical Dispensary
Fort Stewart, Georgia

Dear CPT CHASE:

I just came from the U. S. Army Aeromedical Research Unit (USAARU) where I talked to the experts who tested this helmet and earphone with our present helmet—and a new helmet (SPH-3 modified). They very strongly advise against this change due to the low noise attenuation of the APH-6 earphone. Admittedly it may be more comfortable and could be fitted, but offers very little protection for the ear from noise.

Here is a comparison of noise attenuation offered by these three helmets:

Tests Frequencies in Herts

Herts	APH-5	APH-6	Undergoing Test SPH-3 Modified
75	11.34	3	17.20
125	10.86	3	16.91
250	5.98	0	14.95
500	7.11	−1	24.66
1000	15.37	7	23.38
2000	29.11	10	36.40
3000	47.00	Not tested	47.32
4000	46.26	17	45.94
6000	45.83	Not tested	43.79
8000	35.98	20	36.24

Due to the decreased protection offered by the APH-6, the safest thing to save your ears from possible damage is to wear your earplugs and await the outcome of the new helmet.

PEARL

TIGER BY THE TAIL

Continued from page 49

Operate flash bulbs in the vicinity of fuel and fuel vapors.

Smoke within 50 feet of aircraft, hangars, etc., or within 100 feet of open fuel or fuel transfer operations.

Use electrical appliances which have exposed heating elements in the vicinity of fuel.

Service aircraft or perform any fuel transfer operations while thunderstorms are in progress.

Wear clothing or use cleaning cloths which contain wool, silk, or synthetic fibres.

Use plastic funnels when servicing aircraft.

Perform fueling or defueling operations within 100 feet of aircraft having radar equipment in operation.

Operate aircraft switches or electrical equipment during fueling operations.

Perform maintenance on or around aircraft during fueling operations.

Wear steel taps on toes or heels of shoes.

Carry cigarette lighters or matches.

What about special situations, such as getting rid of contaminated fuel, or performing maintenance inside fuel storage tanks and fuel cells where there is a high concentration of gasoline vapors?

If the amount of waste fuel to be disposed of is small, you may be tempted to pour it down a drain or sewer opening. Don't. Remember, gasoline floats on water, allowing fumes to form and spread. Any ignition source, either at the origin, or at some point remote from where the fuel was dumped, can cause an explosion and fire. It is equally hazardous to pour gasoline on the ground. The safest way to get rid of unwanted gasoline is to collect it in a metal drum and haul it to a designated area for burning.

When working in a concentrated atmosphere of gasoline vapors, all precautions to prevent ignition, *particularly the use of nonsparking tools,* should be followed. Proper respiratory equipment should be worn to prevent being overcome by toxic fumes, and a coworker should be stationed *outside* the fuel vapor atmosphere as an observer.

If fuel is accidentally spilled on clothing, the garments should be removed as soon as possible and the skin areas washed. If gasoline should enter the mouth, ears, or eyes, medical attention should be sought immediately.

Gasoline should be used only as a fuel. It should never be used as a cleaning fluid.

In addition to these precautions, we must constantly be on guard for the "oversight." One example was an aircraft which was serviced in below freezing weather, then moved into a heated hangar to remain overnight for maintenance. Expanding fuel overflowed through the vents and flooded the hanger floor. In this case, quick action by maintenance and fire department personnel prevented a fire.

In another "oversight" example, gasoline samples were to be flown to a laboratory for analysis. Care was taken to place the fuel in metal cans which were then sealed. During the flight, changes in atmospheric pressure, which had not been taken into consideration when the samples were prepared, caused the cans to rupture. Fortunately, the crew was able to jettison them in time to prevent a fire.

Means to extinguish fires and procedures for preserving life and equipment must be a part of all fire safety programs. The choice of an extinguishing agent for any specific application is based on the efficiency of that agent, its toxicity in the normal and decomposed state, and the quantity needed. The most common ones found around airfields and aboard aircraft are carbon tetrachloride, chlorobromomethane (commonly known as CB), foam, and carbon dioxide (CO_2). Each of these possesses certain properties which should be understood for effective firefighting and personal safety.

CARBON TETRACHLORIDE: The least detectable concentration of carbon tetrachloride vapor which can be recognized by smell is reported to be about 72 parts per million (0.0072%). The maximum allowable safe concentration for a daily 8-hour exposure is generally considered to be 25 parts per million (0.0025%). Therefore, if you can smell carbon tetrachloride in the air, it is unsafe for prolonged exposure. When extinguishing fires, this exposure will be of short duration but, in its

TIGER BY THE TAIL

Water is NOT suitable for fighting fuel or electrical fires. However it is effective in containing petroleum fires . . .

decomposed state, its toxic level will be much higher.

For example, one of the by-products formed when carbon tetrachloride contacts flame is deadly phosgene gas. Acute intoxication is characterized by headache, dizziness, and drowsiness. In severe poisoning, there is nausea, vomiting, abdominal pain, and diarrhea. A few hours after exposure, the urine may become scanty and dark colored. The eyes may become puffy, the ankles swollen, and the afflicted person may go into a coma. If the optic nerve is affected, limitation of vision may persist longer than the other symptoms, but recovery generally follows. Carton tetrachloride can be used against all types of fires.

CHLOROBROMOMETHANE (CB): CB is a narcotic agent of moderate intensity but of prolonged duration, and exposure should be avoided. Exposure of high concentrations of the vapor causes such effects as staggering, uncoordination, stupor, confusion, headache, nausea, and dizziness. When CB is heated to decomposition, it emits highly toxic fumes of chlorides and bromides which are irritating and damaging to the lungs. However, the chronic toxicity of CB is definitely lower than that of carbon tetrachloride. As is the case with carbon tetrachloride, CB can be used against all types of fires.

In addition to their harmful vapors, both carbon tetrachloride and CB agents can produce toxic effects if allowed to remain in contact with the skin. Should clothing be saturated, it should be removed as soon as possible and the skin areas thoroughly cleaned. If any adverse reactions are noted, medical attention should be immediately sought.

FOAM: Foam is the most effective blanketing agent for smothering a petroleum fire. A tight covering of foam that excludes all air is spread on the burning surface. This blanket is easily applied to the top of a burning tank or to a large floor surface. Since there is a tendency for foam to break down in fire, application must be continued long enough and fast enough to prevent reignition. The depth of foam required may vary from a few inches for a small tank to several feet for a large one. Foam is generally used only by professional fire fighting personnel.

CARBON DIOXIDE (CO_2): Because of its effectiveness against fuel and electrical fires, and its compressibility in cylinders of various sizes, the portable extinguisher most likely to be found in hangars, shops, on the flight line, and around fuel storage areas is the familiar CO_2 type.

Although we may not realize it, we are constantly associated with carbon dioxide. Our bodies produce it as a waste product which we exhale. If we hold

our breath for a short period of time, we begin to feel a drive to resume breathing. If we continue to hold our breath, this drive increases and we may describe the sensation by saying that our lungs are "bursting" for air. Actually, it is not the requirement for oxygen that causes this drive, but the need to get rid of accumulated carbon dioxide which is toxic.

The initial effect of inhaling carbon dioxide is noticed in concentrations of about 2 percent. Breathing becomes labored and deep. Carbon dioxide absorption will result in excitement, headache, vertigo, drowsiness, dizziness, and muscular weakness, paralleling the symptoms of hypoxia. High concentrations may result in coma or death.

These facts become more significant when we consider that, because it is a gas, carbon dioxide has the ability to diffuse throughout an area, making it particularly hazardous when used in confined places. In addition, its low temperature during discharge from its cylinder can cause severe frost bite (cold burns) on contact with skin. Ironically, these same properties which make it hazardous to humans are the very ones that make it an effective firefighting agent. In use, carbon dioxide is discharged directly against the flame source and works by diluting available oxygen, while decreasing the temperature.

WATER: An attempt to use water to extinguish a fuel-fed fire will only serve to further spread it. Its use against electrical fires may result in electrocution of the operator. For these reasons, water is *not* suitable for fighting fuel or electrical fires. However, it can play a significant role in containing petroleum fires. Should a fire break out in a fuel storage area, for example, water used to hose down other tanks or gasoline drums, as well as any adjacent structure is most effective in preventing its spread. Under certain conditions, it may even be desirable to use water to wash burning fuel away from one area to another, where it can be more easily and safely extinguished. Water and foam, however, should not be used together as water will destroy the effectiveness of the foam, while spreading the fuel.

Other hazards to be considered when attempting to extinguish a fire include the smoke and fumes produced by burning materials. In most instances, these are many times more toxic than extinguishing agents and should be avoided. Should a fire originate inside a closed structure, such as a store room, and it is in an advanced state before being discovered, no attempt should be made to enter the building. Highly flammable vapors are formed during combustion and the smoke generated acts as a smothering agent, preventing their ignition. Opening doors may allow enough oxygen to enter for these vapors to ignite and result in a violent explosion.

To effectively cope with fire requires preparation which should include:

Availability of fire extinguishers of the proper type.

Knowledge of correct use of extinguishers.

Knowledge of the hazards associated with extinguishing agents to be used and necessary precautions.

Maintenance of equipment in serviceable condition at all times.

Establishment of procedures to be followed in event of fire.

SOUND THE ALARM

Because most fires have small beginnings, they are sometimes deceptive and the first few seconds—the most precious ones—may be wasted. The most common error is delay in notifying the fire department while attempting to extinguish it. Should these efforts fail, the fire may spread, placing professional firefighters under a severe handicap when they do arrive. The first step to follow is an obvious one: SOUND THE ALARM! This serves a double purpose: It gives the fire department immediate notice; and it warns other personnel in the area, giving them a chance to evacuate potentially dangerous surroundings. They can then lend their assistance. There should be no reluctance to sound the alarm, even if the fire can possibly be extinguished before fire department personnel can arrive.

Once the alarm has been sounded, portable extinguishers should be put to use immediately. With assistance from others, aircraft, vehicles, and other movable equipment should be moved to a safe area, *without blocking passageways that may be needed to bring in firefighting equipment.* Guides should be stationed to direct fire department personnel to the exact location.

If the fire is inside a hangar or other type structure, electrical power to the building should be turned off at the main switches. This reduces the possibility of additional ignition sources, should wire insulation burn, and eliminates the danger of accidental electrical shock. If the fire is being fed by fuel from a broken hose or line, the flow should be shut off, if possible.

Preventing fires and preserving lives and equipment when fires occur depends largely on knowledge and advance preparations. Continuous fire consciousness by all personnel is essential. You can help!

A SURPRISE FOR WILMA

It was 1,440 miles direct. He thought about calling her, but changed his mind...

Pierce Wiggin

ED WATCHED the girl on the diving board. Her blonde hair was bleached nearly white from the sun and her skin was flushed and tan. Gold freckles powdered her nose. She looked toward him, laughed, and dived into the pool.

Wilma kicked up through the green water, broke the surface, and swam to the edge of the pool. She tugged at her halter and rested her elbows on the tile poolside. "Why don't you come on in? Doctor Smedley said it wouldn't hurt you."

"I'd much rather sit here and watch you. Besides, it wouldn't be safe." He laughed down at her. "The way I feel now, we'd both drown!"

"Down, boy!" She cupped her hand under the water and splashed him.

"Hey, cut it out! This is my last clean uniform!"

She pushed away from the poolside and swam toward the far end and the dressing rooms.

Ed waited beside the entrance and saw Wilma emerge in her white nurse's uniform. He stepped forward, took the bag from her hand, and walked beside her to the parking lot. "Feel better?"

"Wonderful!" She tucked her hand under his arm. "How about you? Think you'll feel like going to the dance tonight?"

"I'd make them put my appendix back in before I'd miss that." He opened the door of her ancient convertible, helped her in, then walked around and got in under the wheel.

Wilma slid across the seat and snuggled up to his side. "Did Doctor Smedley say when he'd release you?"

"I couldn't pin him down. He insisted it would only be a few days, but he wouldn't say when."

"Good!" She rubbed his arm. "I want you completely well before you get back in another airplane." Her eyes moved to his watch. "Hey, we'd better hurry!"

Ed nodded and pressed the accelerator. The engine wheezed and coughed, but they reached the hospital with five minutes to spare. He turned into the staff parking lot and braked to a stop.

Wilma circled his neck with her arms and kissed him. "Bye, honey. You get a good rest and I'll see you tonight." She got out and ran toward the hospital door.

Ed watched until she disappeared inside.

The lobby of the nurses' quarters was filled with girls in evening dresses. Ed waited beside the desk, his eyes on the stairway. He saw Wilma at the landing. She wore a clinging black gown and blonde curls danced over her bare shoulders. She hurried down the stairs and twirled before him.

"How do I look?"

"Good enough to eat!" He pushed a flower box into her hands.

"Ed! Orchids? For me?"

"For you! I plan to make tonight a very special occasion, with a little cooperation on your part."

"You've made a good start." She took his arm and urged him toward the door. "Let's hurry."

He followed her directions and drove to a country club at the edge of town. They parked and followed other couples into a crowded ballroom. A muted trumpet played the opening bars of *Stardust* as he steered her to an empty table and signaled a waiter. "Champagne?"

"You'll spoil me. I'll settle for a beer."

"Waiter, we'll have a bottle of your best imported champagne."

"Yes sir." The waiter hurried away.

"Dance?"

"Hmmm." Wilma rose and walked to the dance floor with him. She moved into his arms, trailed her fingers across the back of his neck, and nuzzled her cheek to his. They danced through a medley, returned to their table, and drank champagne.

"Like to take a walk?"

"Sure." Wilma drained her glass and stood.

They left the club and walked out to the first tee. A quarter moon dimly lit the fairway ahead. Ed drew her to him, lowered his head, and sought her lips. "I've been wanting to do this all evening."

"More, please." She pressed herself against him.

Ed freed one arm and groped in his jacket pocket. He brought out a small jeweler's box and snapped it open. "Do I have to get on my knees, or could you just try this for size?"

"Ed! Oh, Ed! It's beautiful!" She took the box, lifted out the diamond ring and placed it on his hand. "You do it."

Ed slid the ring over her engagement finger, raised her hand, and kissed it. "Now that's all settled, would you like to see what the moon looks like from the sixth green?"

Wilma cupped her hands around her mouth and shouted into the darkness, "FORE!"

The next two days passed swiftly and Ed was discharged from the hospital. Wilma saw him off on the commercial flight that carried him the 1,500 miles back to his unit and lonely nights in the BOQ.

He called her every night, but the telephone proved a poor substitute. Somehow, he just had to get east again to see her. Two weeks later, he got the break he'd been looking for. His CO called him in and asked if he'd like to make a flight to Atlanta.

"Would I! I mean, yes sir!"

"You'll be taking a Beaver and you can get an early start in the morning. With good weather, you should make it in two days."

Ed hurried to operations and entered the flight planning room. He measured off the distance on the wall chart. It was 1,440 miles direct. With a groundspeed of 112 knots, he should be able to make it in 11 hours and 15 minutes. That meant three en route fuel stops, maybe two with luck. If he could get away at 0400, he should reach Atlanta by early evening. And Atlanta meant Wilma. He thought about calling her, but changed his mind and decided he would make it a surprise.

He went to bed immediately after dinner, setting his alarm clock for 0300. When it sounded, he leaped out of bed, hurriedly shaved, donned his

The Beaver reached 10,000 feet and Ed leveled off. The lights of towns a hundred miles away were visible.

flight clothes, and grabbed his bag. He ran out into the darkness.

Operations was very quiet at that hour of the morning and Ed was able to quickly finish his flight planning and file his clearance. According to the forecast, it should be VFR all the way, with maybe a little cumulus over the last third of his route. The sleepy AO looked at the clearance and his eyes widened. "Say, aren't you pushing it, trying to go that far in one day?"

"If you knew what was waiting for me at the other end, you'd wonder why I hadn't already started. I can make it easy. No sweat.

"OK, but I certainly don't envy you. You'll be worn out by the time you get there."

"It's all right. I have a nurse waiting!" Ed grinned and hurried out of the building to the U-6 on the ramp. He put his bag aboard, got out the form, and checked parts two and three. The airplane had been refueled and appeared ready. He stepped down, hurried through his preflight, then climbed into the cockpit.

"Switch on!" He waited for the fire guard's reply and yelled, "Clear!"

The engine caught and roared its red exhaust into the darkness. Ed tuned to tower frequency and called for taxi instructions.

"Army 4579, taxi to runway 24. Wind, southwest, five. Altimeter, 3009. Time, four-zero. Over."

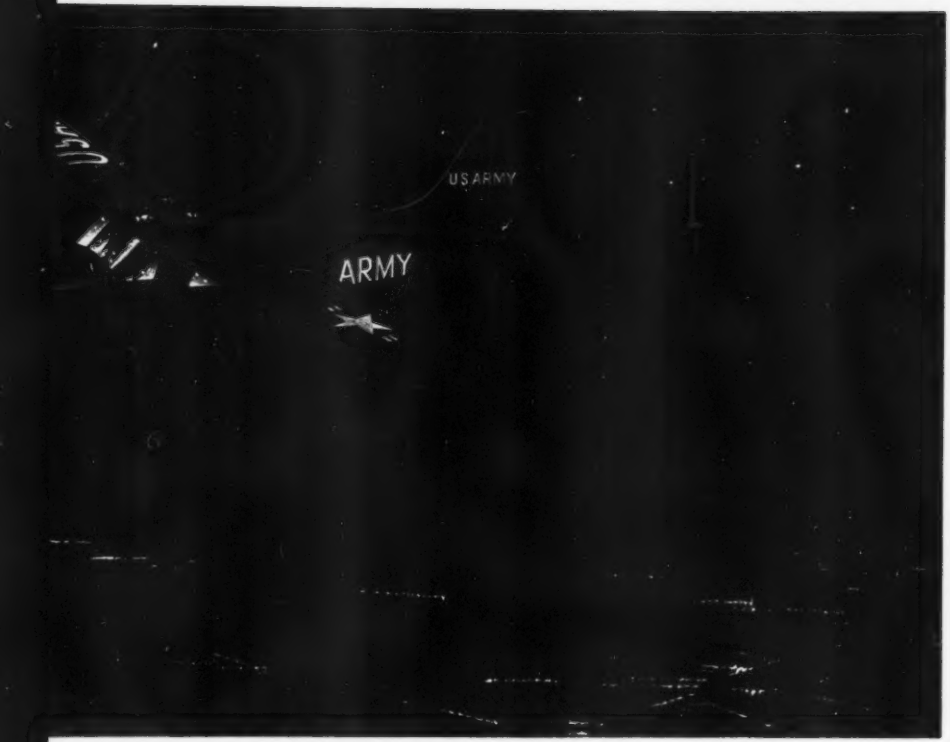
"Roger. Army 579 out." Ed pressed the left brake and rudder and gunned the throttle. The Beaver trundled from the ramp onto the taxiway and rolled toward the runway. He brought it to a stop short of the active, wheeled around, and started his runup.

Ed received takeoff clearance, lined up on the runway, and opened the throttle to 36 inches. The Beaver rolled forward, gathering momentum. He felt the tail get light and held back pressure. The airplane left the ground, its navigation and anti-collision lights flashing. Ed reduced throttle and rpm, pumped the flags to the climb position, and trimmed away the control pressures. He called for permission to make a left turn out to his course.

"Roger, 579. Left turn approved. You were off at five-two. You are cleared from tower frequency. Good day."

Ed placed the mike back on its hook, rolled into a left bank, and continued turning until the directional gyro approached his east heading. He rolled the wings level on course and continued to climb. The forecaster had said he'd find his most favorable winds at 10,000 feet and he intended to take advantage of them.

The Beaver reached 10,000 feet and Ed leveled off. He set the throttle and propeller for cruise, trimmed, and looked around. The lights of towns up to a hundred miles away were plainly visible. He tuned in the omni, identified an on-course station, and watched the needle center as he turned the course selector to his heading. He leaned back and stretched as the Beaver droned through the night. With the omni to navigate by and the airplane trimmed for hands-off flying, there was nothing for him to do but stay alert and watch for other airplanes. He could see the lights of some jets far above. He watched enviously as one passed over him and moved away on the same course he was flying.



The first light streaks of dawn appeared at 0430. Half an hour later, the rim of the sun appeared over a range of mountains. Ed switched off his navigation lights, lit a fresh cigarette, and droned on.

He arrived at his first fuel stop at 0730, landed, and ate a hasty breakfast while the line crew was refueling the U-6. Thirty minutes later, he was back in the air, climbing again to 10,000 feet. Other than a few patches of cumulus off to the east, the sky was clear.

After four hours, Ed tuned the Texarkana Omni and heard its identifying signals. He set his course selector on 082 and bored on into the sun. His back and legs had begun to ache and he loosened his safety belt and shoulder harness to stretch. He checked the fuel gauges and saw that the front tank was still half full. There'd be no sweat making Texarkana. His stomach reminded him it was time for lunch.

Ed landed, taxied to the ramp, shut the engine off, and climbed stiffly down. He logged the flight, then walked to the flight line cafeteria and ordered two cheeseburgers and a chocolate milkshake. When they were served, he gulped them down quickly and hurried back to the ramp. He signed the fuel slip, got abroad, and was again in the air by 1330.

The flight to Jackson, Miss., was uneventful and he arrived at 1745. He landed, checked in with operations, and had another quick meal. The sun was setting behind him as he took off for the last leg to Atlanta. There was a thin layer of cirrus far above him and he could see cumulus on the dark horizon ahead. It appeared to be solid further on.

Ed watched the clock approach 45 past the hour and turned up the volume on the omni to listen for the weather. After naming six other stations and their weather, the voice in his earphones said: "Atlanta. Atlanta municipal. Twelve hundred

broken. Four thousand overcast. Light rain. Altimeter, two-nine-nine-eight."

He stared ahead. Maybe he should see about getting an instrument clearance. No, by gosh! Sure as he did, he'd get held up somewhere and have to hold. The thing to do was to get down below the overcast. With 1,200 broken, he should be able to find a hole and make a VFR approach. Suiting his thoughts to action, Ed lowered the nose and started down. He reduced throttle slightly, but allowed the airspeed to build up. He wanted every knot of speed he could get.

The Beaver's altimeter showed 5,000 feet as he passed under the edge of the overcast. There was about 5/10 of cumulus below. Plenty of holes. Between Birmingham and Atlanta, the clouds under him thickened, but he could see lights on the ground through the holes.

As he approached Atlanta, Ed began to let down again. The tops of the lower clouds were at 3,500 feet and he skirted them, seeking a hole. He saw one, cut the throttle, and dropped the nose to spiral down. The hole was smaller than it had appeared from above. He steepened the bank and pushed the nose further down.

Suddenly, a pair of flashing red and green lights leaped out of the clouds directly in front of him. Ed didn't have time to think about what he should do. Instinctively, he yanked back on the wheel and began rolling out of the bank. There was a lurch and a sickening crunch as the lights passed under him.

Ed held his breath and eased off the back pressure he was holding. The Beaver passed the tops of the clouds and he leveled off, holding the wheel with clenched fingers. His feet beat a tattoo on the rudder pedals and his breath whistled through his teeth.

Forcing himself to move, Ed looked around for the other airplane. All he could see were the clouds and some ground lights through the holes. Timidly, he moved the controls. The U-6 responded normally and the engine roared its usual sound. He took his flashlight and began shining it over the outside surfaces. Then he saw it. Where the left wheel should have been, there was nothing but the jagged end of the landing gear strut. Quickly, he released his safety belt and shoulder harness, got out of his parachute, and squirmed across the cockpit to shine the light on the right gear. It was intact and the wheel appeared undamaged.

Ed returned to his seat, strapped in, and wiped his damp palms on his trouser legs. He looked ahead and saw the glow of Atlanta through the holes in the clouds. His earphones crackled as an excited voice called, "Atlanta, this is 6458! Emergency! We've just had a mid-air collision 10 miles west at 3,000! There's a wheel imbedded in the leading edge of our left wing and we're siphoning fuel! Request straight in approach for runway nine! Over!"

"Six-four-five-eight, this is Atlanta approach control. Turn to heading 089. Descend to and maintain 2,700 feet. You're cleared for a straight in approach for runway nine left. Do you have the other aircraft in sight?"

"Negative, Atlanta. We're IFR!"

Ed reached for his microphone and keyed it. His voice shook as he called, "Atlanta, this is Army 4579, a U-6 Beaver. I'm the pilot of the other aircraft. I'm at 3,500 feet, approximately 10 miles west. My left wheel is gone."

"Army 4579, are you in the clear?"

"Roger, I'm between the clouds."

"Army 4579, maintain your altitude and circle. Acknowledge."

"Army 4579, maintaining 3,500 and circling."

Ed listened as three airliners were diverted. He heard the relief in the other pilot's voice as he called gear down and runway in sight.

"Army 4579, turn to heading 095. Descend to and maintain 2,700 feet."

"Army 4579 turning to 095. Leaving 3,500 now."

As he reached 2,700 feet, Ed was cleared for his approach. The Beaver broke out of the clouds at 2,200 feet and he saw the runway ahead. He reduced power, pumped down flaps, and banked into a right slip as he neared the runway. He rounded out in the slip and touched down on the right gear and tail wheel. Holding full right aileron and left rudder, he felt the Beaver begin to sink to the left as it slowed.

There was a shower of sparks on the runway. The airplane swerved around 180°, slid backwards, and stopped. Ed cut the switches, released himself, and stepped out into the blazing lights of the crash trucks. A sedan with a rotating red light on its roof raced down the runway and braked to a stop beside

him. The driver got out. "You all right?"

"I think so."

"Get in, please. The inspector wants to see you."

Ed signed his name in the last blank of the lengthy form, wearily rubbed his hand across his face, and glanced at the clock on the wall. Its hands showed 2230. He passed the form to the grim faced inspector behind the desk. "I think that's all, sir."

"Not quite, lieutenant. I've notified the Army and they'll have an investigation team here in the morning. We'll expect you to be on hand."

"Yes sir. May I go now?"

"Let me make sure I have the facts straight. You left before dawn this morning, flew almost 12 hours, then tried to make it in here VFR, even though you knew we had instrument weather. Is that correct?"

"Yes sir."

"Why, lieutenant, why? You're instrument rated. Why didn't you call for an IFR clearance?"

"I was afraid it would delay me."

"So, rather than risk a delay, you decided to let down through a hole in the clouds and collided with another airplane that was on a proper IFR clearance. That decision almost cost six lives. You must have had a very important reason for getting here on time. Mind telling me what it was?"

"I wanted to surprise my girl friend."

The inspector's face reddened. He gripped the edge of his desk. "You broke regulations, risked your neck and the lives of those other people because you wanted to surprise a girl?"

"Yes sir."

"Lieutenant, I know lots of Army Aviators. They're all fine pilots, mature, and completely dependable. What happened with you?"

"Happened, sir? I don't understand."

"No, I don't expect you do. What I'd like to know is how you went through all that training and became a rated aviator without growing up. What you did tonight was childish and immature." He shook his head slowly and stared at Ed. "You'd better go and get some rest. You're going to have a rough day tomorrow!"

Ed left the office and hurried to a pay telephone in the hall. He dialed Wilma's number and slumped against the wall. After a dozen rings, he hung up and dialed again, hoping he'd dialed a wrong number on the first try. There was no answer. He hung up, walked outside, and hailed a taxi.

When the taxi pulled up before the darkened nurses' quarters, Ed paid the driver and got out. He paced up the walk and sat on the brick steps in front of the door. He smoked and stared at his watch. The minute hand crept slowly around the dial. The drizzle had stopped, leaving the air cool and damp. As he finished his cigarette, he stamped it out on the bricks, stood, and paced to the sidewalk. He stared up and down the empty street, looked at his watch again, then walked back to the steps. He sat and beat his fists on his knees, then lit a fresh cigarette and puffed smoke into the cool air.

Where could she be? Not at the hospital, he knew. She wasn't scheduled for night duty for another two weeks. It had to be another man! Why would she be so late if it wasn't? How long was he going to have to sit on those hard bricks while she was out having fun with someone else?

He counted ten butts on the steps, crushed his empty cigarette package, and threw it into the street. Angrily, he stood to leave as a car drew up to the curb. He watched as Wilma got out. She waved gaily to the man under the wheel and walked to the steps.

"Ed! Where did you come from?" She ran forward, arms outstretched.

He pushed her arms aside and shoved her back. "Where have you been? Who was that?"

"Ed! This isn't like you. What's the matter?"

"Matter? I've been sitting here half the night after flying all day, while you're out cavorting around with another man! And you want to know what's the matter! Are you crazy?"

Her smile faded. "Ed, I don't like you this way. Maybe you'd better leave and call me tomorrow."

"Call you tomorrow! I'm calling right now, and I want to know who that was!"

"Keep your voice down, please! You'll wake the other nurses!"

He shouted louder, "Wilma, who was it?"

"None of your business!"

"I thought—"

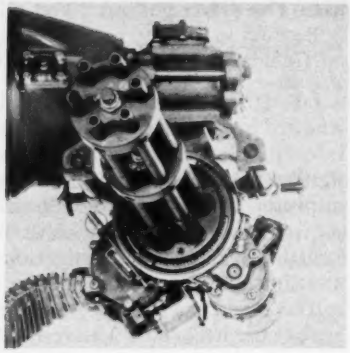
"You thought! Did you think about letting me know you were coming? Did you think I'd sit here every night waiting for you to surprise me?"

"But, you—"

"I spent the evening with my sister and her husband. That was my brother-in-law!" She glared at him, jerked the ring from her finger, and threw it at his feet. "Here, junior! Come back and try again when you've grown up!"

She marched up the steps and through the door.

This story is fiction. There was no Ed, no Wilma, no mid-air collision, and no inspector. But there was an aviator who tried to fly 14 hours in one day under similar circumstances, and who tried to make a VFR approach to another airport through low clouds. He did not collide with another airplane. He collided with a mountain.



Left, crewchiefs prepare one of their new rapid fire miniguns for a mission with the 334th Armed Helicopter Company. The weapons system employs six rotating barrels that fire at the rate of 6,000 rounds per minute. Above, the minigun as it looked while undergoing tests.

The Year of the Mini

COULD THIS BE "The Year of the Mini"?

The word minify means "shorten or lessen." The dazzling skirts that delighted London during the summer and hung around to endure the freezing winds of midwinter Chicago were definitely shortened and lessened.

However, the "mini" in the new miniguns being used in Vietnam means anything but "lessen."

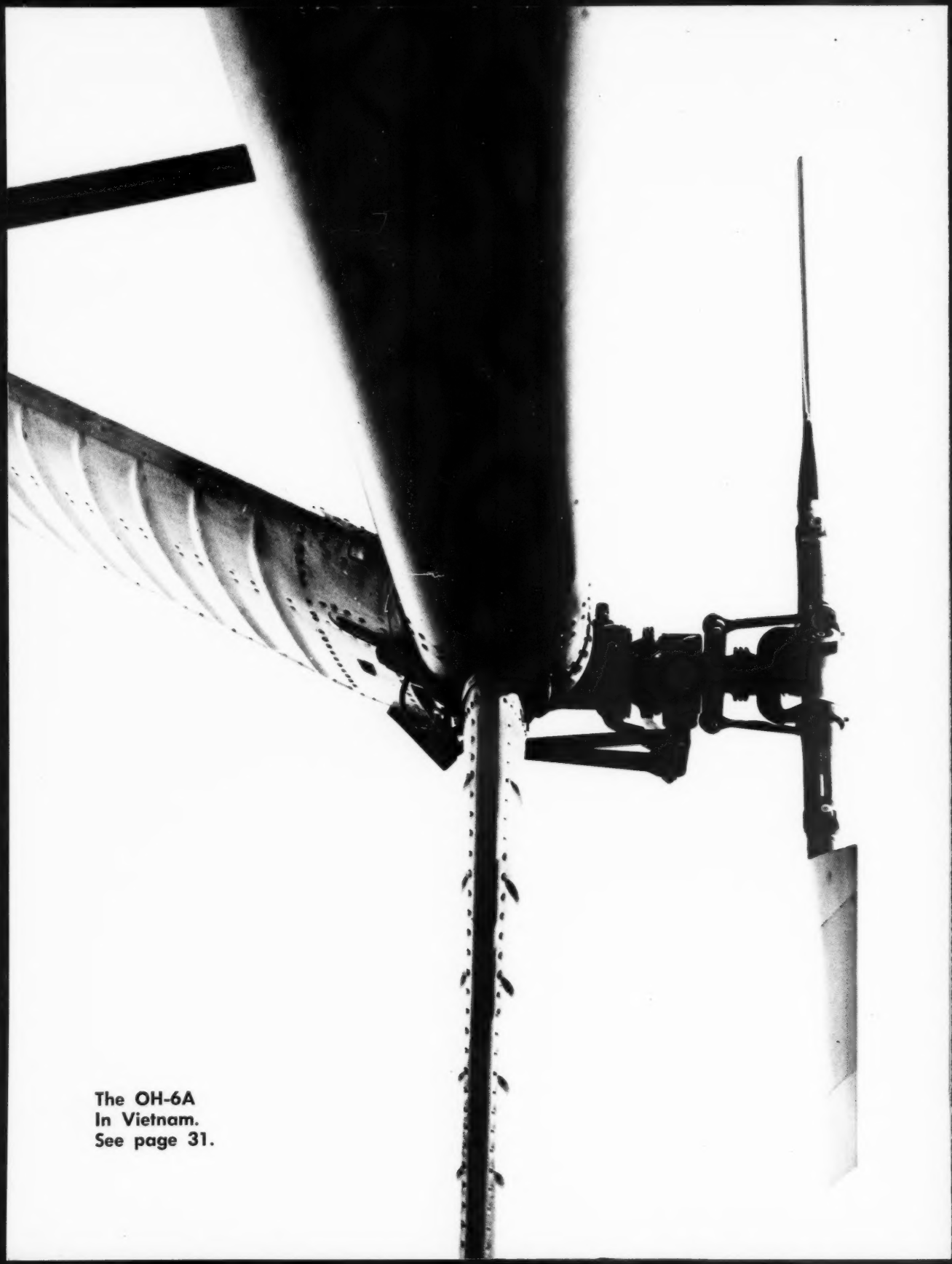
Army aviation units in Vietnam employing armed helicopters have started to receive the XM-21 minigun weapons system. The new weapon, designed to increase the reliability, firepower and overall destructive capabilities of armed Hueys is being installed on the majority of the armed helicopters flown by the 334th Armed Helicopter Company of the 145th Combat Aviation Battalion.

The minigun system closely resembles the old Gatling gun in that it employs six rotating barrels firing in sequence to obtain its high rate of fire. The system has such a high rate of fire that it would consume most of the aircraft's basic load of ammunition within minutes if it were fired in one long burst. The weapon is fired at interrupted bursts so the ammunition is conserved and the barrels remain within their heat range.

The system is capable of flexing even further than did the older quad mounted M-60 machineguns. It can fire forward, almost straight out from the sides of the helicopter, or straight down to penetrate the thick jungle canopy.

Pilots of the 334th Armed Helicopter Company report that the system is deadly accurate and the high rate of fire makes it "rain lead in a steady stream." As the monsoon season leaves the delta, the "mini birds" of the 334th will continue to provide the Viet Cong with "showers."

THE ARMY has already ordered 530 of these high speed AH-1G HueyCobras to provide our Vietnam forces with the additional speed and cruising range to engage in a firepower strike while on an escort mission and still return to complete the primary escort duty. The AH-1G can deliver two tons of devastating firepower. It is powered with a 1,400 hp Lycoming gas turbine and has exceeded 200 mph in level flight.



The OH-6A
In Vietnam.
See page 31.